"Technical/Agency Draft"

CALIFORNIA CONDOR
(*Gymnogyps californianus*)

Fourth Edition

RECOVERY PLAN
(Original Approved: 1975)
(First Revision Approved: 1979)
(Second Revision Approved: 1984)

Prepared by the California Condor Recovery Team
(see attached list)

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for
Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: ______________________

Date: ______________________

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received
10-8-94

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DISCLAIMER PAGE

Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service **only** after they have been signed by the Regional Director or Director as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and completion of recovery tasks.

Literature Citations should read as follows:

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EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR THE CALIFORNIA CONDOR
(*Gymnogyps californianus*)

Current Species Status: The California condor (*Gymnogyps californianus*) is federally listed as an endangered species. The current population is 82, including 76 individuals in captivity at the Los Angeles Zoo, San Diego Wild Animal Park, and World Center for Birds of Prey, and 6 captive-produced birds released to the wild in 1992-1993 in Ventura and Santa Barbara counties, California.

Habitat Requirements and Limiting Factors: California condors require suitable habitat for nesting, roosting, and foraging. The recent range was restricted to chaparral, coniferous forests, and oak savannah habitats in southern and central California. The species formerly occurred more widely throughout the Southwest and also fed on beaches and large rivers along the Pacific coast. Nest sites are located in cavities in cliffs, in large rock outcrops, or in large trees. Traditional roosting sites are maintained on cliffs or large trees, often near feeding sites. Foraging occurs mostly in grasslands, including potreros within chaparral areas, or in oak savannahs. At present, sufficient remaining habitat exists in California and in southwestern states to support a large number of condors, if density independent mortality factors, including shooting, lead poisoning, and collisions with man-made objects, can be controlled. The possibility of eventual genetic problems, resulting from the species' recent perilously low population size, cannot be discounted.

Recovery Priority: 1C

Recovery Objective: Downlist to threatened.

Recovery Criteria: The minimum criterion for reclassification to threatened is the maintenance of at least two non-captive populations and one captive population. These populations (1) must each number at least 150 individuals, (2) must each contain at least 15 breeding pairs and (3) be reproductively self-sustaining and have a positive rate of population growth. In addition the non-captive populations (4) must be spatially disjunct and non-interacting, (5) must have sufficient permanently secure habitat to meet the above criteria, and (6) must contain individuals descended from each of the 14 founders.

Actions Needed:

1. Establish a captive breeding program to preserve the gene pool.
2. Reintroduce California condors to the wild.
3. Minimize mortality factors in the natural environment.
4. Maintain adequate habitat for condor recovery in the wild.
5. Implement information and education programs on condor habitat use, identification, and protection needs.

Total Estimated Cost of Recovery

Cost ($1,000's)

Year	Need 1	Need 2	Need 3	Need 4	Need 5
1995	658.0	582.0	83.0	128.0	37.0
1996	643.0	590.0	83.0	193.0	37.0
1997	643.0	895.0	83.0	218.0	237.0
1998	643.0	890.0	83.0	218.0	237.0
1999	643.0	870.0	83.0	148.0	237.0
2000	650.0	850.0	85.0	150.0	50.0
2001	650.0	850.0	85.0	150.0	50.0
2002	650.0	850.0	85.0	150.0	50.0
2003	650.0	850.0	85.0	150.0	50.0
2004	650.0	850.0	85.0	150.0	50.0
2005	650.0	850.0	85.0	150.0	50.0
2006	650.0	850.0	85.0	150.0	50.0
2007	650.0	850.0	85.0	150.0	50.0
2008	650.0	850.0	85.0	150.0	50.0
2009	650.0	850.0	85.0	150.0	50.0
2010	650.0	850.0	85.0	150.0	50.0
Total Costs	10,380.0	13,177.0	1,350.0	2,555.0	1,335.0

Date of Recovery: Downlisting should be initiated in 2010, if recovery criteria are met.

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I. INTRODUCTION

Brief Overview

The California Condor (*Gymnogyps californianus*) was listed as endangered on March 11, 1967, (32 FR 4001) in a final rule published by the U.S. Fish and Wildlife Service (Service). The Service then established critical habitat for the California condor nine years later on September 24, 1976, (41 FR 187).

Long recognized as a vanishing species (Cooper 1890, Koford 1953, Wilbur 1978), the California condor remains one of the world's rarest and most imperiled vertebrate species. Despite intensive conservation efforts, the wild California condor population declined steadily until 1987, when the last free-flying individual was captured. During the 1980s, captive condor flocks were established at the San Diego Wild Animal Park and the Los Angeles Zoo, and the first successful captive breeding was accomplished at the former facility in 1988. Following several years of increasingly successful captive breeding, captive-produced condors were first released back to the wild in early 1992, and two additional releases were subsequently conducted.

Physical Characteristics

California condors are among the largest flying birds in the world. Adults weigh approximately 10 kilograms (22 lbs) and have a wing span up to 2.9 meters (9 1/2 ft). Adults are black except for prominent white underwing linings and edges of the upper secondary coverts. The head and neck are mostly naked, and the bare skin is gray, grading into various shades of yellow, red, and orange. Males and females cannot be distinguished by size or plumage characteristics. The heads of juveniles up to 3 years old are grayish-black, and their wing linings are variously mottled or completely dark. During the third year the head develops yellow coloration, and the wing linings become gradually whiter (N.J. Schmitt in prep.). By the time individuals are 5 or 6 years of age, they are essentially indistinguishable from adults (Koford 1953, Wilbur 1975, Snyder et al. 1987), but full development of the adult wing patterns may not be completed until 7 or 8 years of age (N.J. Schmitt in prep.).

Taxonomy

The California condor is a member of the family Cathartidae or New World vultures, a family of seven species, including the closely related Andean condor (*Vultur gryphus*) and the sympatric turkey vulture (*Cathartes aura*). Although the family has traditionally been placed in the Order Falconiformes, most contemporary taxonomists believe that New World vultures are more closely related to storks (Ligon 1967, Rea 1983, Sibley and Ahlquist 1990).

Prehistorical Range

The fossil record of the genus *Gymnogyps* dates back about 100,000 years to the Middle Pleistocene Epoch (Brodkorb 1964). At the Rancho La Brea tar pits in Los Angeles, abundant condor remains occur with many contemporary species, including American Robins (*Turdus migratorius*), Scrub Jays (*Aphelocoma coerulescens*), and Mourning Doves (*Zenaida macroura*) (Howard 1962). Fossil records reveal that the species once ranged over much of the southern United States, south to Nuevo Leon, Mexico and east to Florida (Brodkorb 1964), and two well preserved fossil bones were reported from a site in upstate New York (Steadman and Miller 1987). There is evidence indicating that California condors nested in west Texas, Arizona, and New Mexico during the late Pleistocene (Emslie 1987). The disappearance of the California condor from much of this range occurred about 10,000-11,000 years ago, coinciding with the late Pleistocene extinction of the North American megafauna (Emslie op cit.).

Historical Range

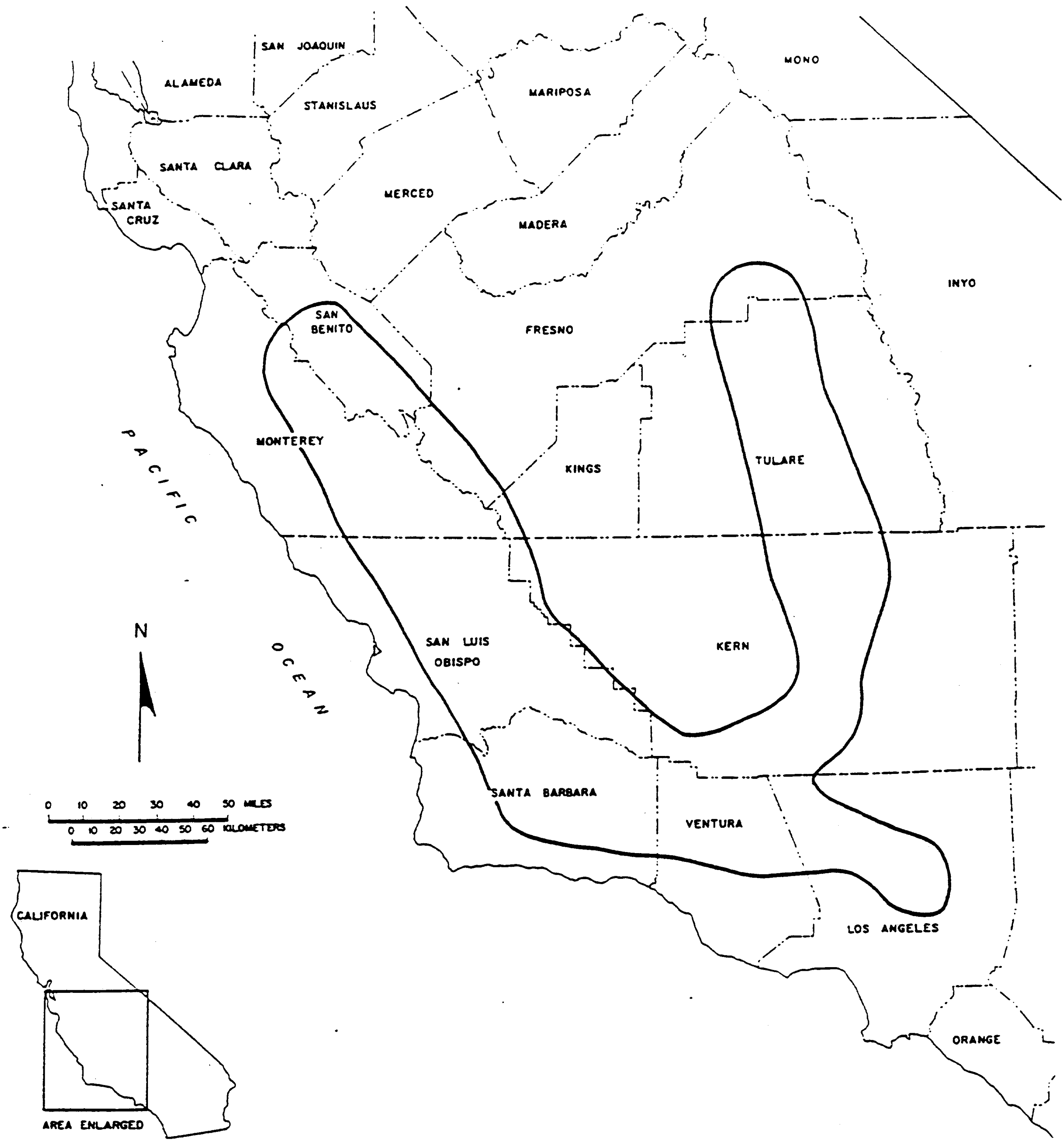
By the time of the arrival of European man in western North America, California condors occurred only in a narrow Pacific coastal strip from British Columbia, Canada to Baja California Norte, Mexico (Koford 1953, Wilbur 1978). California condors were observed until the mid-1800s in the northern portion of the Pacific Coast region (Columbia River Gorge) and until the early 1930s in the southern extreme (northern Baja California) (Koford 1953, Wilbur 1973, Wilbur and Kiff 1980). Prior to 1987, California condors used a wishbone-shaped area encompassing six counties just north of Los Angeles, California (Fig. 1).

Life History

The following details of condor life history are based largely on studies of the wild condor population prior to 1987, principally those of condor biologists Carl Koford (1939-1947), Fred Sibley (1965-1969), Sanford Wilbur (1969-1980), and Noel Snyder and his associates (1980-1985).

California condor life history information can be conveniently categorized into nesting, foraging, and roosting components. This section summarizes condor biology, habitat requirements, and range as they relate to each component on a daily basis and over the annual cycle. A concluding discussion summarizing the traditional movement of condors throughout their recent historical range is also provided.

Nesting Courtship and nest site selection by breeding California condors occur from December through the spring months. Reproductively mature, paired California condors normally lay a single egg between late January and early April. The egg is incubated by both parents and hatches after approximately 56 days. Both parents share responsibilities for feeding the nestling. Feeding usually occurs daily for the first two months, then gradually diminishes in frequency. At two to three months of age condor chicks leave



Range of the California Condor
Figure I

the actual nest cavity, but remain in the vicinity of the nest where they are fed by their parents. The chick takes its first flight at about six to seven months of age, but may not become fully independent of its parents until the following year. Parent birds occasionally continue to feed a fledgling even after it has begun to make longer flights to foraging grounds.

Because of the long period of parental care, it was formerly assumed that successful California condor pairs normally nested successfully every other year (Koford 1953). However, this pattern seems to vary, possibly depending mostly on the time of year that the nestling fledges. If a nestling fledges relatively early (in late summer or early fall), its parents may nest again in the following year, but late fledging probably inhibits nesting in the following year (Snyder and Snyder 1989).

California condors may lay a replacement clutch if their first (Harrison and Kiff 1980) or even second egg is lost (Snyder and Hamber 1985). Whether they lay a replacement egg may depend on the time of year, at what stage of incubation the egg is lost, individual variation, and perhaps genetic or climatic factors. Among Andean condors and other captive cathartid vultures, some females will apparently lay three or even four clutches in a season, while others invariably lay only one or two (M. Wallace, Los Angeles Zoo, in litt.).

Because subadult birds had never been observed in the wild as members of breeding pairs, Koford (1953) concluded that California condors did not breed before six years of age, the time at which the adult plumage is acquired. The only wild California condor (a male) of known age bred successfully in the wild in 1986 at the age of six years. Recent data collected from captive birds, however, demonstrates that reproduction may occur, or at least be attempted at earlier ages. A four-year old male was the youngest California condor observed in courtship display, and the same bird subsequently bred successfully at the age of five years (M. Wallace, Los Angeles Zoo, in litt.).

California condors nest in various types of rock formations including crevices, overhung ledges, and potholes, and, more rarely, in cavities in giant sequoia trees (*Sequoia giganteus*) (Snyder et al. 1986). An evaluation of various nest parameters, including types, elevations, compass orientation, entrance sizes, depths, chamber characteristics, substrates, use of nests by other species, accessibility to predators, presence of porches, and proximity to roost perches and sources of human disturbance, indicated that all surveyed California condor nest sites (n = 72) share the following characteristics: (1) entrances large enough for the birds to fit through, (2) a ceiling height of at least 38 cm at the egg position, (3) fairly level floors with some loose surface substrate, (4) unconstricted space for incubating adults, and (5) short distance accessibility to a landing point (Snyder et al. op cit.). The factors influencing the choice of nest sites by condors is poorly understood. The appearance of many nest sites suggests that they have been in long use, perhaps for centuries, whereas other apparently suitable sites in undisturbed areas show no signs of condor use.

The effects of human disturbance on nesting condors have been difficult to evaluate rigorously, and different observers have reached disparate conclusions. Koford (1953) documented numerous accounts of human disturbance at California condor nest sites. He reported that the responses of nesting birds were highly variable and hypothesized that the nature of the birds' reactions might depend upon the stage of nesting. Koford generally concluded that California condors were keenly aware of intruders, and would alter their behaviors if humans approached in sight within 555 m (500yd) of a nest. In addition, Koford stated that California condors could be alarmed by loud noises from distances of over 1.6 kilometers (1mi). Based on these observations, Koford recommended that human disturbance should be restricted within 1.6 km (1mi) of active nest sites.

Sibley (1969) found a correlation between the location of recently used California condor nest sites and the location and magnitude of human activity. He concluded that the greater the disturbance, either in frequency or noise level, the less likely California condors were to nest nearby. In 1984, a nest site located in a giant sequoia tree within mixed-conifer forest was subjected to a high degree of disturbance during the egg-laying period because it was located on the edge of an active clearcut timbering operation. Nevertheless, the breeding attempt continued successfully until the half-grown chick was removed from the nest to be added to the captive flock. Based on the variety of historical accounts, Snyder et al. (1986) concluded that tolerance to disturbance by nesting condors is likely to be a highly variable trait individually and that it is prudent to continue the current U.S. Forest Service restriction of human activities within 2.4 km (1.5mi) of California condor nest sites.

Although potential condor nesting habitat still exists over a relatively large portion of the coastal and interior mountains in central and southern California, the recently occupied nesting range was quite limited. After 1910, all recorded nesting sites were located in the Coast, Transverse, and Sierra Nevada mountain ranges (Koford 1953, Meretsky and Snyder 1992, Wilbur and Kiff in prep.). All but one of the nest sites used between 1979 to 1986 were in a narrow belt of chaparral and coniferous forested mountains from central Santa Barbara County across northern and central Ventura County to northwestern Los Angeles County. The sites were located within a total area approximately 90 km (56mi) from west to east and only about 15 km (9mi) from north to south. The only nest outside this area was located in a giant sequoia in Tulare County in 1984. It is possible that condors may have been nesting in the latter area over the years since the nest was only a few miles from another giant sequoia nest which was active in 1951. All recent California condor nest sites were located on public lands within the Los Padres, Angeles, and Sequoia National Forests.

Foraging California condors are opportunistic scavengers, feeding only on the carcasses of dead animals. Typical foraging behavior includes long-distance reconnaissance flights, lengthy circling flights over a carcass, and hours of waiting at a roost or on the ground near a carcass. Seasonal foraging behavior shifts perhaps are the result of climatic cycles or to changes in food availability. Condors maintain wide-ranging foraging patterns throughout the year, an important adaptation for a species that may be subjected to unpredictable food supplies (Meretsky and Snyder 1992). Having located a potential food item, California condors frequently remain in the air circling high above the carcass before landing. As with other scavenging species that are known to feed socially, this circling behavior is thought to serve as a signal to other conspecifics, guiding them to available food sources (Houston 1974, Mundy 1982, Wallace and Temple 1987, Meretsky and Snyder 1992). Once on the ground condors may feed immediately, or wait passively as other California condors or golden eagles (*Aquila chrysaetos*) feed on the carcass (Wilbur 1978).

Prior to the arrival of European man, condor food items within interior California probably included mule deer (*Odocoileus hemionus*), tule elk (Cervus nannodes), pronghorn antelope (*Antilocapra americana*), and smaller mammals. Along the Pacific shore the diet of the California condor may have included whales, sea lions, and other marine species (Emslie 1987, U.S. Fish and Wildlife Service 1984). Koford (1953) listed observations of California condors feeding on 24 different mammalian species within the last two centuries. He estimated that 95 percent of the diet consisted of cattle, domestic sheep, ground squirrels (*Spermophilus beechyi*), mule deer, and horses. Over half of the observations Koford reported were of condors feeding on cattle carcasses, and most of those were calves. While beef cattle may be the most available food within the range of the condor, a clear preference for deer over cattle has been observed (Koford 1953, Wilbur 1972, Meretsky and Snyder 1992). California condors appear to feed only one to three days per week, but the frequency of adult feeding is variable and may show seasonal differences.

Most California condor foraging occurs in open terrain of foothill grassland and oak savannah habitats. Although the California condor is not as ungainly on the ground as portrayed in popular literature, it does require fairly open spaces for feeding. This ensures easy take-off and approach and makes food finding easier. As mentioned earlier, mule deer are possibly a "preferred" food, yet deer tend to drift toward canyon bottoms to die (Taber and Dasmann 1958, Blong 1954), where steep terrain and brush interfere with California condor foraging. Carcasses under brush are hard to see, and California condors apparently do not locate food by olfactory cues (Stager 1964).

The principal foraging regions used by California condors from the late 1970s to 1987 were the foothills bordering the southern San Joaquin Valley and axillary valleys in San Luis Obispo, Santa Barbara, Kern, and Tulare Counties. After 1982, most observations of feeding by the small remaining wild population of California condors occurred in the Elkhorn Hills-Cuyama Valley-Carrizo Plain complex, and in the southern San Joaquin Valley (Meretsky and Snyder 1992). The majority of important foraging areas were on private cattle-grazing lands.

The Elkhorn Hills-Cuyama Valley-Carrizo Plain area includes portions of San Luis Obispo, Santa Barbara, and Kern counties. California condors foraged in the eastern part of San Luis Obispo County, generally east of the Los Padres National Forest boundary and west of the Temblor Mountains. Observations of radio-tagged birds along San Juan Creek in the 1980s indicated foraging in the upper drainage, south of Highway 58. Farther south, the Carrizo Plain, Panorama Hills, and the Elkhorn Plain in the region between the Caliente and Temblor Mountains were also commonly used (U.S. Fish and Wildlife Service 1984).

Foraging in Santa Barbara County was mainly to the north in portions of the Cuyama Valley and, occasionally, on potreros along the ridge line of the Sierra Madre Mountains. A nesting pair in Santa Barbara County also foraged in the Santa Ynez Valley to the south, mainly along the northern portions as far west as the Los Olivos area and the Zaca Creek drainage (U.S. Fish and Wildlife Service 1984).

In Kern County, California condors foraged extensively in the foothills adjacent to the northern boundary of Los Padres National Forest, to Reyes Station in the west, to the Pleito Hills west of Interstate Highway 5, and eastward throughout much of the region from the Tehachapi Mountains north to the slopes of Cummings Mountain (Studer 1983). This entire region, like the similar foraging country in the Carrizo and Elkhorn Plains, is fairly close to traditional nesting sites (U.S. Fish and Wildlife Service 1984).

The San Joaquin Valley foraging region was located in eastern Kern, Tulare, and Ventura counties. An important foraging area in Kern County was the foothill rangelands around Glennville. There, California condors roosted primarily on National Forest lands in the Greenhorn Mountains and foraged daily in the Cedar Creek and upper Pozo Creek drainages as far west as Blue Mountain and the old Granite Station crossroads south of Woody, California. In Tulare County, California condors foraged extensively through the oak savannah and grassland hill country north from the Kern County border and west of the National Forest boundary, including the Tule River Indian Reservation (U.S. Fish and Wildlife Service 1984). As in northern Kern County, important roosting sites were to the east on higher slopes in Sequoia National Forest and on higher peaks within the foraging zone, including Blue Ridge. California condors recently foraged as far north as the Lake Kaweah region, with the White River, Deer Creek, Lake Success, and Yokohl Valley areas being of special importance (U.S. Fish and Wildlife Service 1984).

Although these foraging regions have been identified as being important to California condors since 1980, they should not be considered as all inclusive. Like most scavenging birds, California condors are opportunistic. Through the course of a year they fed on carcasses found in many locations. California condors were known to feed at U.S. Fish and Wildlife Service baiting stations on the Tejon Ranch and Hopper Mountain, Bitter Creek, and Blue Ridge National Wildlife Refuges. The birds may be expected to take advantage of local abundance of food almost anywhere within their normal range. California condors were not reported in many areas of this former range after the mid-1980s, especially north in the Coastal Range to Monterey and San Benito Counties, but also east into the San Gabriel Mountains in Los Angeles County.

Roosting Depending upon weather conditions and the hunger of the bird, a California condor may spend most of its time perched at a roost. California condors often use traditional roosting sites near important foraging grounds (U.S. Fish and Wildlife Service 1984). Although California condors usually remain at roosts until mid-morning, and generally return in mid- to late afternoon, it is not unusual for a bird to stay perched throughout the day. While at a roost, California condors devote considerable time to preening and other maintenance activities. Roosts may also serve some social function, as it is common for two or more California condors to roost together and to leave a roost together (U.S. Fish and Wildlife Service 1984). California condors apparently will tolerate more disturbance at a roost than at a nest. Roosting sites and nesting sites are susceptible to similar disturbance threats, and their preservation requires isolation from human intrusion. There may be adaptive as well as traditional reasons for California condors to continue to occupy a number of widely separated roosts, such as reducing food competition between breeding and non-breeding birds.

Cliffs and tall conifers, including dead snags, are generally utilized as roost sites in nesting areas. Although most roost sites are near nesting or foraging areas, scattered roost sites are located throughout the range.

Movements

Data on locations and movements of California condors discussed here are limited mainly to those collected between 1982 and 1987, as summarized by Meretsky and Snyder (1992). These data were obtained primarily from radiotelemetry studies and the analysis of flight photographs of known California condors (Snyder and Johnson 1985, Meretsky and Snyder 1992) and summarized below. For detailed information on historical California condor range, the reader should refer to Koford (1953) and Wilbur (1978).

Studies during the 1980s showed that the last California condors remaining in the wild prior to 1987 comprised a single population of birds occupying a range of 2 million hectares (800,000 acres). Insofar as could be determined, every California condor in the wild was familiar with the entire range of the species and was capable of soaring between any two points within the range in single day. While no difference in movement patterns could be detected between sexes, a difference in the mobility was noted between breeding and nonbreeding condors. Immatures and other unpaired condors seemed to be especially mobile, with the longest recorded flight during a single day by an immature male being 225 km (141mi). Yearling condors do not venture far from their nest sites until late in their first year, and they gradually increase their distance from their natal area as they mature. Based on the available information, however, it was not possible to ascertain at what age immature condors begin their wide-ranging forays. Paired birds tended to forage most frequently in areas relatively close to their nests, not normally venturing more than 50 km (31mi) to 70 km (44mi) from their nest sites; although on one occasion a member of a nesting pair travelled 180 km (113mi). It should also be noted that during the non-breeding season paired birds tended to expand their home range to encompass more of the available foraging areas.

Seasonal shifts that were noted seemed to be based generally on food availability. For example, condors tended to move to the Tehachapi area during the hunting season where they showed a preference for deer gut-piles and abandoned deer carcasses were preferred over calf carcasses. Furthermore, during the calving season in the San Emigdio area of the San Joaquin Valley foraging region, wild California condors were frequently observed feeding on naturally occurring calf carcasses.

California condors use topography and associated thermal weather patterns for flight. This is best illustrated by observations indicating that almost all flights by California condors, whether covering long distances or not, followed routes over the foothills and mountains bordering the southern San Joaquin Valley. It was rare for a California condor to pass directly over the flat, highly agricultural floor of the Valley. Thus, the usual route for a bird starting from the coastal mountains of Santa Barbara County on its way to foraging grounds in Tulare County was to cross northern Ventura County, pass through the Tehachapi Mountains in southern Kern County, then turn north to pass closely by Breckenridge Mountain, and enter Tulare County somewhere between the Greenhorn Mountains and Blue Mountain. Where flat, agricultural regions are much less extensive, such as the Cuyama Valley in Santa Barbara and San Luis Obispo Counties, California condors freely passed high above en route to foraging grounds. It has become apparent that California condors are highly dependent on topography since it dictates prevailing wind patterns. (U.S. Fish and Wildlife Service 1984).

<u>Population Trends</u>

Condor censusing efforts through the years have varied in intensity and accuracy. This has led to conflicting estimates of historical abundance, but all have indicated an ever-declining California condor population. Koford

(1953) estimated a population of about 60 individuals in the late 1930s through the mid-1940s, apparently based on observed flock size. A field study by Eben and Ian McMillan in the early 1960s suggested a population of about 40 individuals, again based in part on the validity of Koford's estimates of flock size (Miller et al. 1965). An annual October California condor survey was begun in 1965 (Mallette and Borneman 1966) and continued for 16 years. This effort was typically a two-day simultaneous observation and count of California condors at prominent observation points in areas of known concentration. Interpretation of the results of these surveys was made difficult by variations in weather conditions, number of observers, and other factors from year to year, but the results supported an estimate of 50 to 60 extant California condors in the late 1960s (Sibley 1969, Mallette 1970). Wilbur (1980) continued the survey efforts into the 1970s and concurred with the interpretations of the earlier October surveys. He further estimated that by 1978 the population had dropped to 25-30 individuals.

Snyder and Johnson (1985) later re-assessed the earlier population estimates of Koford (1953) and Miller et al. (1965) and concluded that they may have underestimated the size of the condor population by a factor of two or three. Regardless of the actual number of birds, the trend toward extinction of the wild condor population was linear and unrelenting. In 1981, the U.S. Fish and Wildlife Service (Service), in cooperation with California Polytechnic State University at San Luis Obispo, began census efforts based on individual identifications of birds through flight photography (Snyder and Johnson 1985). Minimum summer counts from these photocensusing efforts showed a steady decline from an estimated minimum of 21 wild condors in 1982, 19 individuals in 1983, 15 individuals in 1984, and 9 individuals in 1985. Although the overall condor population increased slightly after 1982 as a result of double clutching, the wild population continued to decline. By the end of 1986, all but two California condors were captured for safekeeping and genetic security. On April 19, 1987 the last wild condor was captured and taken to the San Diego Wild Animal Park. Beginning with the first successful captive breeding of California condors in 1988 the total population has increased annually and now stands at 82 individuals, including 76 in the captive flock and 6 in the wild (Fig. 2).

<u>Reasons for Decline</u>

Causes of the California condor population decline have probably been numerous and variable through time. However, despite decades of research, it is not known with certainty which mortality factors have been dominant in the overall decline of the species. Relatively few dead California condors have been found, and definitive conclusions on the causes of death were made in only a small portion of these cases (Miller et al. 1965, Wilbur 1978, Snyder and Snyder 1989).

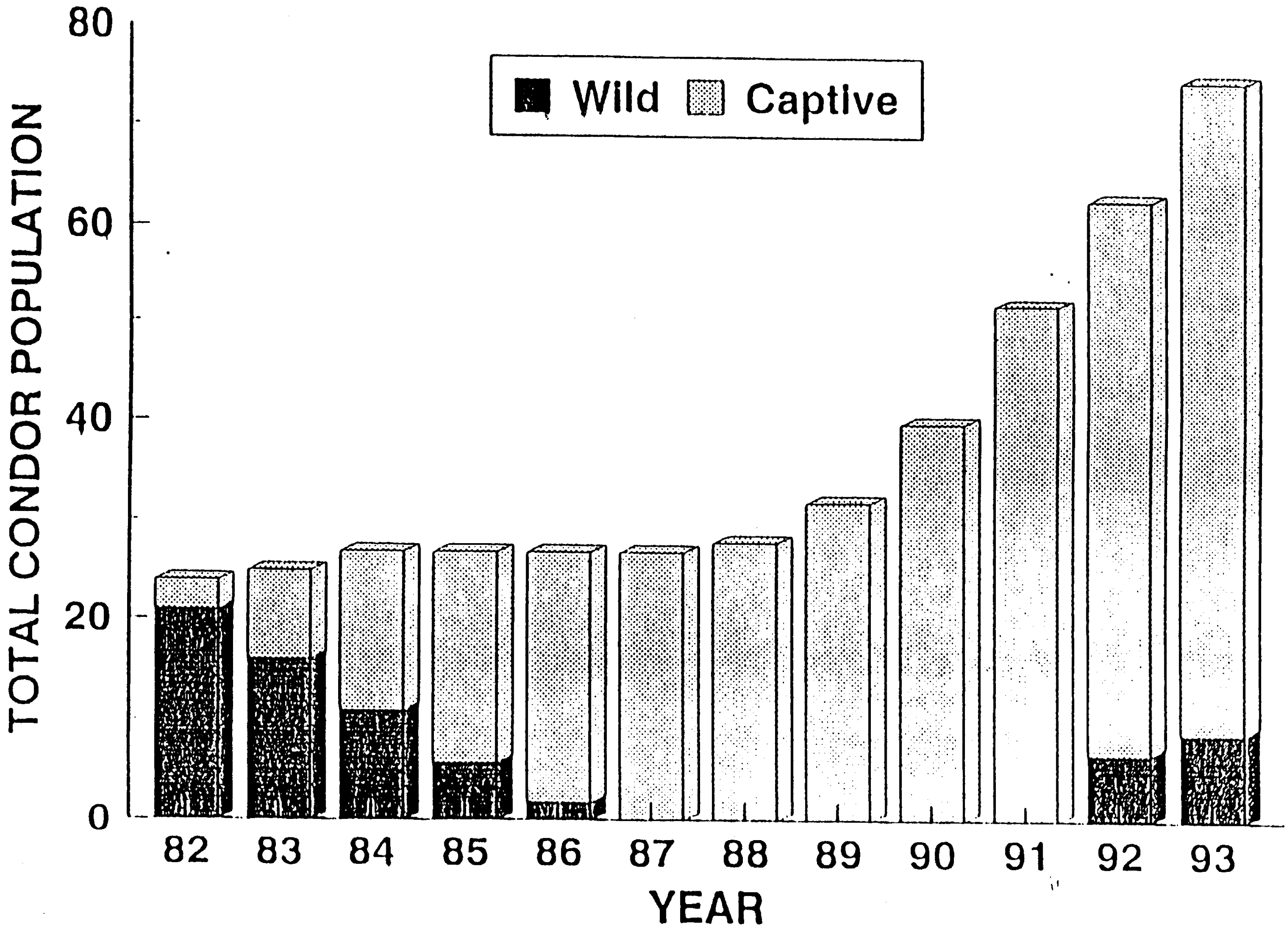


Fig. 2. California Condor population, 1982-1993.

Although the information regarding California condor mortality is inconclusive, there is evidence to suggest that two human-induced factors, lead poisoning and shooting, have contributed disproportionately to the decline of the species in recent years. Although publicity associated with the condor recovery program has doubtless reduced the likelihood of condors being shot, two persons were arrested as recently as July 1992 for shooting at a California condor that was part of a reintroduction program, thus indicating the need for continued public education and an enforcement presence to protect the species from wanton shooting.

Post-mortem examinations performed on four California condors found dead since 1983, indicated that three of the birds died from the effects of lead poisoning (Janssen et al. 1986, Wiemeyer et al. (1988), and one died of cyanide poisoning (Wiemeyer et al. op cit.). High lead levels, presumably obtained from the ingestion of fragments of lead bullets in shot mammal carcasses, may be a pervasive problem throughout the historical foraging range of the California condor. For example, Bloom et al. (1989) and Pattee et al. (1990) found elevated levels in one-third of 162 golden eagle blood samples taken in the range of the California condor in 1985-1986, and Wiemeyer et al. (1988) concluded that lead exposure was the major factor having an adverse impact on the wild California condor population between 1982-1986. The possible effects on condors of another highly toxic heavy metal, copper, have not been investigated, but Wiemeyer et al. (1983) reported unusually high copper levels in the liver tissue of an immature condor found dead from unknown causes in 1974.

Cyanide poisoning is considered to be a highly improbable occurrence and is therefore not likely to be a major cause of the decline of the species. Equally improbable was the recent death of a released condor from the ingestion of ethylene glycol, presumably as the result of drinking antifreeze. Deaths from one or more range poisons, including strychnine and various rodenticides, may have occurred historically, but convincing documentation of the occurrence and magnitude of such losses has not been documented.

Kiff et al. (1979) reported severe thinning and ultrastructural abnormalities in California condor eggshells collected in the late 1960s by F. Sibley. They attributed this to the probable effects of 1,1-dichloro,-2,2-bis(p-chlorophenyl)etylene (DDE), a breakdown metabolite of the pesticide 1,1,1-trichloro-2,2-bis(p-chloro-phenyl)ethane (DDT). DDT was banned for domestic use in the United States in 1972, and virtually all condor eggshell samples collected after 1975 have exhibited normal thickness (Snyder et al. ms). However, two eggs laid in 1986 by the last female California condor (Stud Book 12) to breed in the wild were very thin (44% thinner than the historical mean thickness) and contained inexplicably high levels of DDE and the parent compound, DDT (Kiff 1989). Indeed, the first-laid of these eggs was crushed, probably by the weight of the incubating bird, before it could be removed for captive incubation. The effect of eggshell thinning on the condor population cannot be accurately assessed now, but it could have been a serious factor during the 1950s-1960s. Significant eggshell thinning has also been reported for the congeneric turkey vulture within the region of sympatry with the California condor (Wilbur 1978c, Kiff et al. 1979, Wiemeyer et al. 1986). Organochlorine concentrations were low in four condors analyzed for these contaminants between 1980-86 (Wiemeyer et al. 1988), but the highly contaminated eggs from 1986 indicate that continued monitoring of such compounds in condors and surrogate species is warranted.

One of the Andean condors in an experimental release program died from a collision with a power line near Hopper Mountain National Wildlife Refuge in 1989, and, more recently, three of the California condors released in late 1992 were lost from the same cause in 1993. At least two deaths from collisions with manmade objects, including power lines, were known historically (Koford 1953). Such deaths suggest that future condor releases should be conducted in areas remote from human settlements with their attendant condor hazards.

Other factors formerly contributing to the decline of the species were egg and specimen collecting, capture of live birds for sport or display, Indian ceremonial use, drowning in uncovered oil sumps. All such activities are now illegal and no longer believed to represent threats to California condors.

Deaths of adult California condors from natural causes are virtually unknown. Rett (1938) reported two adult California condors killed by hail, and he later reported the probable cause of another California condor death as osteomyelitis (Rett 1946). California condor eggs and nestlings are vulnerable to natural predators. According to Snyder (1986), ravens were observed taking two eggs and have been observed attempting to take others. Golden eagles have been observed at least twice attempting to capture condor nestlings, and on one occasion a black bear (*Ursus americanus*) was seen making an unsuccessful attempt to take a nestling (Snyder 1986).

Although not considered a significant factor in the decline of the species, reproductive problems have been noted in recent years. Two pairs, engaged in otherwise normal breeding behavior, failed to successfully copulate on repeated attempts. Based on his observations in the field Snyder (1989) speculated that the pair may have been homosexual; however, one of these birds later paired with another California condor in captivity and reproduced successfully (Cox pers. comm.). One deceased female (Stud Book 10) produced chicks with morphological abnormalities on several occasions. Another founder female (Stud Book 12) lays unusually small eggs, but continues to reproduce successfully and is well represented by progeny in the captive population. This trait appears to be heritable through the female line, and her offspring have also laid relatively small eggs (Kuehler et al. 1991). This bird was the last female to breed in the wild.

Population Modeling

Verner (1978) constructed a model predicting that a stable California condor population could not be maintained with mortality rates over 9 percent annually in adults coupled with 11 percent annually in immatures, or 7 percent annually in adults coupled with 15 percent annually in immatures. The model employed the following assumptions: (1) age of first breeding is six years age, (2) 80 percent of the adults are members of breeding pairs, (3) nesting success is approximately 50 percent, (4) 50 percent of nesting failures occur early enough for renesting, and (5) annual nesting occurs only after early fledging of young. The known mean annual mortality rate for the years 1982 through 1986 was 23.8 percent (24 percent for adults and 23.1 percent for immatures). These percentages clearly indicate the significance of mortality to the decline of the species.

Based on the historical information, the decline of the California condor is more likely attributable to excessive mortality of free-flying birds than to reproductive failure. Review of the available data on recent reproductive success of the California condor does not suggest significant difficulties with reproduction (Snyder and Snyder 1989). Between 1980 and 1985, with a sample of 17 pairs, studies revealed 41 to 47 percent nest success (Snyder and Snyder op cit.). These figures are very similar to historical breeding records of California condors and to that of other cathartid and Old World vultures (Jackson 1983, Mundy 1982). Snyder (1983) suggested that condor reproductive success had held fairly constant through historical times, based upon a comparison of nest success figures from the 1940s (Koford 1953), late 1960s (Sibley 1969), and Snyder's own data from the early 1980s. However, since the principal causes of nest losses during each period were mostly human-induced, directly or indirectly, and apparently specific to each era, it may not be possible to determine "natural" rates of California condor nest success.

Conservation Measures

Despite decades of legal protection and extensive conservation efforts, condors continued decline in numbers in the wild throughout the twentieth century. As a crucial attempt to prevent the extinction of the California condor the decision to capture all remaining wild California condors for safekeeping and genetic security was made by the Service and the California Fish and Game Commission in late 1985. This controversial decision was a dramatic shift from previous conservation efforts to recover the species primarily through habitat protection. The following section provides a brief chronology of conservation efforts.

Legal protection was first provided to the California condor by the State of California through a series of avian "protective" laws which were promulgated around the turn of the century (Wilbur 1978). The California condor was protected by the State of California at least as early as 1901. The law was nonspecific, merely prohibiting the taking of any nongame bird or its eggs or nests without a permit. In 1908, a constable was fined $50.00 for shooting a California condor in the San Gabriel Mountains near Pasadena (Finley and Finley 1928). In 1917 an illegally captured California condor was confiscated, but no one was prosecuted (Anonymous 1917). In general, early nongame laws were not strictly enforced, and a number of California condors were shot and eggs were collected until about 1920.

Official concern began to be expressed for the California condor by the mid-1930s. At the urging of Robert O. Easton, a Santa Barbara County rancher, and the National Audubon Society (Audubon Society), the U.S. Forest Service (Forest Service) established the Sisquoc Condor Sanctuary in 1937. This encompasse 1198 acres in Santa Barbara County that include an important condor roost, nest site, and bathing pool. Following field studies by Carl Koford between 1939 and 1946, the Sespe Condor Sanctuary was established in 1947 in the Los Padres National Forest in Ventura County. Originally about 35,000 acres, the Sespe Condor Sanctuary was enlarged in 1951 to include approximately 53,000 acres. These two sanctuaries remain under the administration of the Forest Service. The Sisquoc Condor Sanctuary is closed to all non-permitted entry, and the Sespe Condor Sanctuary is also closed to all non-permitted entry with the exception of two narrow travel corridors that allow hikers and horseback riders to pass through the area.

The first specific legal mention of the California condor was in 1953. Section 1179.5 of the California Fish and Game Code stated: "It is unlawful to take any condor at any time or in any manner. No provision of this code or any other law shall be construed to authorize the issuance of a permit to take any condor and no such permit heretofore issued shall have any effect for any purpose on and after January 15, 1954." The California condor was retained in this "fully protected" status with no authority to issue any type of permit for trapping or handling, until 1971. At that time the Fish and Game Code was amended (Stats. 1970, Ch. 1036) to allow issuance of permits for collecting fully protected species when necessary for scientific purposes.

An Audubon Society-sponsored field survey in 1963-64 resulted in the hiring of an Audubon Society "condor naturalist" in 1965. In the same year, the Service initiated the Endangered Wildlife Research Program, and a research biologist was assigned to study the California condor in 1966. Both Audubon Society and Service positions were occupied until recently. From 1968 to 1973, the Forest Service employed a California condor biologist to prepare a comprehensive California condor habitat management plan for the national forests. The California Department of Fish and Game (Department) maintained a full-time California condor biologist from 1982-1989. Cooperation and assistance from other individuals and agencies have been coordinated through the Service and the California Condor Recovery Team (Team).

The California condor was recognized by the Federal government as "endangered" in 1967, but the first specific Federal legal protection did not occur until 1972 when the U.S. Migratory Bird Treaty with Mexico was amended to include vultures and certain other families of birds. The passage of the Endangered Species Act of 1973 (Public Law 93-205) made the taking of any endangered species a violation of Federal law.

An important outgrowth of Federal endangered species legislation was the concept of critical habitat. According to Section 7(a)(2) of the Endangered Species Act of 1973, as amended, "each Federal agency shall in consultation with and with the assistance of the Secretary [of Interior] insure that any action authorized, funded, or carried out by such agency... is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary ... to be critical." About 570,400 acres of critical habitat (Section 3(5)(A) has been determined for the California condor (50 CFR 17./95), in six Southern California counties; Ventura, Los Angeles, Santa Barbara, San Luis Obispo, Kern and Tulare (Appendix 1).

Considerable effort to preserve California condor habitat was made from the late 1960s through the 1980s, yet the species continued to decline rapidly. The Team prepared the first draft "California Condor Contingency Plan" in 1976. This document recommended captive breeding and other intensive recovery efforts. A revised version was approved "in concept" in 1977 by the Service. In 1978, a panel of experts appointed by the American Ornithologists' Union and the Audubon Society prepared a report on the California condor that recommended an aggressive program of trapping condors for captive breeding and radiotelemetry studies (Ricklefs 1978). These reports led to the signing of a Cooperative Agreement in 1979 among the Service, Audubon Society, Department, Forest Service, and U.S. Bureau of Land Management. The purpose of the agreement was to expedite the California condor recovery effort and to cooperate on providing information and education. The Condor Research Center was established in 1980 by the Service and the Audubon Society as a result of this agreement.

In May, 1980, Federal and State permits authorizing the capture of a condor for captive breeding and equipping 10 wild condors with radiotelemetry devices were approved. However, the State permit was rescinded in the following month when a condor chick died while being examined by a field team from the Condor Research Center. A permit to capture a condor for captive breeding was renewed in August, 1981, but a suitable bird could not be found because of the restrictive provisions of the permit.

The Department approved the use of patagial-mounted radios in January 1982, and two California condors were captured and equipped with these devices late in 1982. For the first time, photocensusing techniques yielded an accurate estimate of the number of extant California condors (Snyder and Johnson 1985), and it was found that the species had reached an apparent minimum population size of 22 individuals. In 1982, a wild California condor chick was captured and brought safely into captivity. "Double-clutching" by one of the wild pairs was documented beyond question in 1982 (Snyder and Hamber 1985), and this led in 1983 to the issuance of a permit to bring the first-laid eggs of breeding California condors into captivity.

The years 1983 and 1984 were critical ones in the formation of the captive California condor flock at the San Diego Wild Animal Park and Los Angeles Zoo. Two chicks and four eggs were taken from the wild to the San Diego Wild Animal Park in 1983; all eggs hatched successfully. In 1984, six out of eight eggs taken to this facility were hatched successfully. In addition, another chick was captured and added to the captive population in 1984. For the first time in the recorded history of the California condor, the overall population increased in number.

Eventually, nine free-flying California condors were equipped with radiotelemetry devices, and their movements were followed by field technicians. The photocensusing project continued, and it indicated that the wild condor population consisted of 15 individuals in the fall of 1984. Among these birds were five breeding pairs, and it seemed possible that the growing captive flock would soon be able to produce releasable offspring well in sufficient time to forestall the extirpation of the wild population. However, disaster struck during the winter of 1984-85, and six birds were lost from the wild population. The causes of the disappearances of the birds could not be determined, as none of them was among the individuals equipped with a radio device. Their loss left only one breeding pair of California condors in the spring of 1985.

By April, 1985, there was widespread sentiment that all of the remaining wild birds should be brought into captivity in order to ensure the genetic viability of the species and to enhance the chances of success in the captive breeding program. This position was formally endorsed by the California Fish and Game Commission and a panel of 10 prominent population geneticists, and it was supported by most of the California Condor Recovery Team members. An American Ornithologists' Union Committee on the California condor favored the capture of all the wild birds for biological reasons, but recommended that three birds be left in the wild in order to maintain the integrity of habitat preservation efforts and the momentum of the condor recovery program until the captive-reared birds could be released.

In June, 1985, the Service recommended the capture of three of the remaining nine wild birds, but (with Audubon Society backing) also advocated the release of three of the birds then held captive. This proposal became a matter of considerable contention, but the situation was finally resolved in December, 1985, when the Service recommended the immediate capture of all remaining wild California condors. Immediately preceding this decision, one of the six remaining wild California condors, a breeding female, was found suffering from lead poisoning and was taken to the San Diego Wild Park, where she died in January, 1986.

The Service decision to capture all remaining wild California condors resulted in a lawsuit by the Audubon Society, and a temporary injunction preventing trapping of the remaining wild birds was issued. The matter was not resolved until June, 1986, when the court ruled in favor of the Service's position. At about this time administrative responsibility for the California Condor Recovery Program was transferred from Patuxent Wildlife Research Center (Region 8) to the Service's Region 1 office in Portland, Oregon. There were still five condors in the wild, including one breeding pair. By the end of the summer, all but three of these birds had been captured. The present Team was formed in August, 1986, and its first recommendation was to capture the last free-flying condors. One of the birds was taken into captivity before the end of 1986, and another was captured in January, 1987. The last individual was captured on Easter Sunday, April 19, 1987.

Other important actions during this period included the acquisition by the Service of the 1,800 acre Hopper Mountain National Wildlife Refuge as a buffer for the Sespe Condor Sanctuary and the 13,500 acre Hudson Ranch (now Bitter Creek National Wildlife Refuge), an important condor foraging area in the southern San Joaquin Valley. DNA "fingerprinting" studies to elucidate the relationship of all living and some recently dead California condors were conducted by Dr. Oliver Ryder at the San Diego Zoo, and they indicated that the captive population contained 14 different founders, representing three "clans." Using these data and the known histories of the captive birds, a computer model was generated to determine the best pairings from a genetic standpoint.

Prior to the beginning of the intense condor management program in the 1980s, the only living captive California condor was a bird ("Topatopa") that had been captured at the age of 11 months in 1967 and held at the Los Angeles Zoo. In 1983 the decision was made to take into captivity eggs produced by wild California condors, and in that year three eggs from first clutches were collected and hatched at the San Diego Wild Animal Park. Removal of the eggs stimulated the production of replacement clutches in two of the pairs. One of those eggs was also taken and hatched in captivity, and the other was lost to common ravens (*Corvus corax*). In addition, two nestlings were taken into captivity in 1983. In 1984, eight eggs and one chick were taken into captivity. Six of the eggs hatched. The following year, three eggs were taken; two hatched. By 1986 only one breeding pair of California condors survived in the wild, and they produced two eggs, one of which was hatched in captivity.

The first successful breeding of California condors in captivity occurred at the San Diego Wild Animal Park in 1988, when a chick, "Molloko," was produced by a pair of wild-caught condors. Four more chicks were produced at the San Diego Wild Animal Park and Los Angeles Zoo in 1989. The number of chicks produced by captive California condors continued to increase annually (Fig. 2), and the captive population grew from 27 birds in 1987 to 76 birds by the spring of 1994.

The Team approved a protocol for the selection of additional condor captive propagation facilities in February 1988, and solicitations were made to candidate zoological institutions for proposals. The two leading proposals were received from The Peregrine Fund, Inc. in Boise, Idaho (World Center for Birds of Prey) and the National Zoo at Front Royal, Virginia. Both institutions were recommended by the Team as sites for additional condor captive propagation facilities in September 1990 with the expectation that the former facility would be in operation first. Twelve condors, genetically selected to form six breeding pairs, were transferred from the two existing condor facilities to the World Center for Birds of Prey on 23 September 1993. In addition, the Team recommended in February 1993 that the George M. Sutton Avian Research Center in Bartlesville, Oklahoma be approved as an additional condor captive propagation facility.

In October, 1986, the Team recommended criteria to be satisfied before a release of captive-bred California condors could take place. These included having three actively breeding pairs of condors, three chicks behaviorally suitable for release, and retaining at least five offspring from each breeding pair contributing to the release. The Team recommended that all California condors then in captivity should be retained for captive breeding purposes. In June 1989 the Team added a provision to the third criterion to retain a minimum of seven progeny in captivity for founders that were not reproductively active.

Some of the chicks produced in the 1991 breeding season met all three criteria, and two of these chicks were eventually released to the wild. However, attempting to apply the first criterion to the 1991 chicks also revealed that it would not be practical in the future, because several founders had died without producing five progeny. The Team therefore recommended choosing genetically appropriate chicks for future releases based on pedigree analyses developed for the genetic management of captive populations. These pedigree analyses evolve over time as the results of new research are incorporated. The analyses currently available are described in Ralls and Ballou (1992).

Prior to the capture of the last wild California condor in 1987, the Team recognized that the anticipated future releases of captive-reared California condors would pose the problem of reintroducing individuals of an altricial bird species into habitat devoid of their parents and other members of their own species. Thus, the Team recommended the initiation of an experimental release of Andean condors in order to test the suitability of one or more potential release sites for California condors, to field test release methods, to compare test captive rearing techniques, and to train an effective field team for future releases. Initial research objectives for the experimental release were to refine condor release and recapture techniques developed with black and turkey vultures in Florida and Andean condors in Peru, test the criteria being used to select California condor release sites, develop written protocols for the release and recapture of California condors, identify potential problems peculiar to the California environment, field test rearing protocols being used, or proposed for use, to produce California condors suitable for release, evaluate radiotelemetry packages, and train a team of biologists for releasing California condors.

Other benefits of the Andean condor experimental release included identifying environmental hazards associated with selected release sites, and the development and implementation of measures to eliminate, or plans to avoid those hazards prior to the release of California condors. There were also public relations benefits gained from the widespread notice received by the project. Andean condors not only served as a surrogate study species, but the release project also helped maintain momentum for the California condor recovery program and condor habitat protection during the period when California condors were not in the wild.

This project began in August 1988, when a group of four immature female Andean condors was released from a fabricated release site on Hopper Mountain National Wildlife Refuge. Later in 1988, four more female Andean condors were taken to a nearby release site within the Sespe Condor Sanctuary. The birds were reared at each site until they reached fledgling age approximately eight months of age. At that time, the netting was removed from their enclosures, and the birds were allowed to fly freely. During 1989, six more female Andean condors were added to the experimental release population. The project was continued until December 1991 and resulted in the acquisition of important knowledge about the best procedures for releasing California condors. Following their experimental release in the Sespe area, the Andean condors were removed gradually from the wild and eventually transported to Colombia and Venezuela, where they were released to the wild. Male Andean condors had already been released in Colombia as a by-blow of the California Condor Recovery program, beginning in 1989. By this time, Andean condors were completely extirpated in Venezuela, and the Colombian population numbered no more than 20 individuals. Of 22 captive-reared Andean condors released into Colombia between 1989-1991, 19 still survived by 1993 (Lieberman et al. op cit.).

By the end of the 1991 breeding season several captive-produced condor chicks met the criteria for releases established by the Team in 1986, and the Team recommended the release of two individuals in the Sespe Condor Sanctuary in the winter of 1991-92. Coincidentally, the chicks were the offspring of the last breeding pair in the wild, both then mated with different adults because of genetic considerations.

The first release occurred on 14 January 1992, when two captive-produced California condor chicks, "Xewe" (female) and "Chocuyens" (male), were released with two Andean condor chicks at a site in the Sespe Condor Sanctuary. The Andean condors were released with the California condors to create a larger social group. The Andean condors were returned to captivity in September 1992, thus marking the end of the 3-year experimental Andean condor release project. The young California condors continued to fare well until Chocuyens was found dead at Pyramid Lake, Ventura County, on 8 October 1992, where he had died from ingesting ethylene glycol, a component of antifreeze.

The next release of California condors occurred on 1 December 1992, when six more captive-produced California condors chicks were released at the same Sespe Condor Sanctuary site. Socialization with Xewe, the remaining individual from the first release, proceeded well, and the "flock" appeared to adjust well to wild conditions. However, there was continuing concern over the tendency of the birds to frequent zones of heavy human activity, especially the Pyramid Lake area. Indeed, three of these birds eventually died from collisions with power lines in the Castaic area between late May-October 1993.

Because of the tendency for the remaining birds to be attracted to the vicinity of human activity and man-made obstacles, especially power lines, another condor release site was constructed in a more remote area, Lion Canyon, located on U.S. Forest Service lands near the boundary of the San Rafael Wilderness Area in Santa Barbara County, California. Five condors of the year were released at the new site on 8 December 1993. In addition, the four condors that had been residing in the Sespe area were also moved to the new site. They were re-released over a period of several weeks in hopes that this approach would reduce the probability that they would return to the Sespe area. Nevertheless, three of these condors eventually moved back to the Sespe-Castaic-Fillmore area in March 1994, where they resumed the high risk practice of perching on power poles. Because of general concern about the tameness of these birds and the possibility that their undesirable behavior would be mimicked by younger condors, these birds were retrapped on 29 March 1994 and added to the captive breeding population.

Supplemental feeding is an integral component of the condor release program. Prior to the recent condor management era, Wilbur et al. (1974) and Wilbur (1978b) showed that California condors could easily be attracted to artificial food sites, and "vulture restaurants" have long been in operation in several Old World vulture conservation programs.

Based on the encouraging results of the Andean condor surrogate release experiment, condor field technicians have continued to feed the released California condors on still-born dairy calves, and there has been little evidence that the birds have utilized any other food items. Although it is not expected that free-flying condors will continue to feed on proffered food indefinitely, the supplemental feeding program should continue to reduce the likelihood of deaths of condors from lead or other poisoning insofar as it prevents the birds from feeding on contaminated carcasses. In addition, feeding sites can be strategically located in order to influence movements of the birds. Finally, supplemental feeding can permit the reintroduction and maintenance of condor populations in areas where the supply of natural food resources is too variable to support the birds over the entire annual cycle.

To satisfy the objectives of the Plan, at least one subpopulation of non-captive condors must be established in an area disjunct from the subpopulation being reestablished in the recent historical range in California. Following the widely publicized solicitation of suggestions for suitable condor release sites outside of California and the approval of a site selection protocol (March 1987), the Team recommended in December 1991 that California condor releases be conducted in northern Arizona. In July 1993, the Team recommended that a condor release project be undertaken at Ladder Ranch in New Mexico. Other areas, including the Gray Ranch in New Mexico and the Sierra San Pedro Martir, Baja California Norte, Mexico, have been discussed as possible release sites. Releases at any of the foregoing sites should not preclude California Condor releases at any other non-California site.

The first two releases took place in the Sespe-Piru Condor Critical Habitat Area, one of nine designated Condor Critical Habitat Areas located in Southern California. The third release was not located within or near critical habitat and the recently released captive-produced California condors have yet to occupy or use any critical habitat. The use of designated critical habitat is not a priority element in the selection of California condor release sites. The current release site is not located within critical habitat and there are no future plans to use critical habitat for California condor releases. The selection of critical habitat areas was based on nesting, roosting, and foraging habitat traditionally used by generation after generation of wild California condors. Recently released captive-produced birds have no bonds to these critical habitat areas, so it is difficult to predict the level of use they will recieve in the future. Not until we have larger numbers of condors in the wild, including breeding pairs, will we be able to evaluate the effectiveness of existing critical habitat.

Strategy of Recovery
The recovery strategy for the California condor will focus on (1) artificially increasing reproduction in captivity to provide birds for release, (2) the release of condors to the wild, (3) control mortality by modification of both human and condor behavior, and (4) protect habitat historically used by California condors.

II. RECOVERY

A. Objectives and Criteria
The primary objective of the California Condor Recovery Plan (Plan) is reclassification of the California condor to threatened status. This plan provides the criteria for reclassification and outlines the requisite actions for the accomplishment of each criterion.

The minimum criterion for reclassification to threatened is the maintenance of at least two non-captive populations and one captive population. These populations (1) must each number at least 150 individuals, (2) must each contain at least 15 breeding pairs and (3) be reproductively self-sustaining and have a positive rate of population growth. In addition the non-captive populations (4) must be spatially disjunct and non-interacting, (5) must have sufficient permanently secure habitat to meet the above criteria, and (6) must contain individuals descended from each of the 14 founders. When these six conditions are met the species should be reclassified to threatened status. The accomplishment of these objectives will depend upon reducing mortality to the lowest level possible and ensuring the interchange of individuals among the spatially isolated free-living sub-populations and the captive flock. The Team must agree that a reintroduction program has been successful before reclassification occurs.

In addition, productivity must be increased beyond the California condor's intrinsic reproductive rate through a captive breeding program. The long-term population goal of this program is to manage the captive flock to maintain 90 percent of the initial genetic variance of the represented founders for 200 years. The ultimate size of this population is dependent upon the number of founders, the growth rate of the captive flock, and the generation length of the species. A preliminary estimate of the captive population size is approximately 50 pairs.

The short-term population objectives set here are based on preliminary population viability considerations (Appendix 2). The viability factors that have been considered include genetics, demography, and environmental variation, including the possibility of catastrophes and epidemics. The roles and interactions of these factors are set out in Soulé (1987).

Restoration of the California condor throughout its historical range, or restoration of a population only within its recent historical range is not an objective of the recovery plan.

The estimated date for reclassification to threatened is 2010. These reclassification criteria may be revised on the basis of new information. Population levels of free-living California condors that would justify the species' removal from the Threatened and Endangered Species List cannot be determined at this time.

B. Narrative

1. Preserve Gene Pool.

Single populations are at higher risks of natural or human-caused disasters than are multiple sub-populations. Therefore, at least five captive sub-populations of California condors should be maintained to produce birds for the establishment of viable wild sub-populations.

11. Maintain extensively managed captive breeding programs at a minimum of five zoological institutions.

Captive California condor flocks should be managed to maximize production while optimizing genetic diversity. Optimum pairing strategies for captive birds should be based on genetic information, behavioral data, logistical considerations, and any other pertinent data. In the short term, demographics should be emphasized with the expectation that in the long term, genetic considerations will become increasingly important in managing condor populations.

111. Update standardized management protocols.

Captive breeding/rearing protocols have been developed and are being implemented. Continue to update, revise, and standardize existing protocols for veterinary, husbandry, transport, captive-breeding techniques, and emergency procedures to ensure the health, safety, and productivity of captive condors.

112. Operate existing breeding facilities according to management protocols.

Existing captive-breeding facilities located at the Los Angeles Zoo, San Diego Wild Animal Park, and the World Center for Birds of Prey should be operated in accordance with approved captive/rearing protocols.

113. Develop additional captive-breeding facilities.

The development of additional captive-breeding facilities is necessary for three reasons, (1) safety - single populations are more susceptible to natural or human-caused disasters than multiple sub-populations, (2) space - additional facilities are necessary to accommodate the growing captive population, and (3) cost - the existing captive breeding facilities cannot be expected to assume the total cost of maintaining the growing captive population. Additional captive-breeding facilities should be developed as needed to accommodate the growing captive population.

12. Manage the captive flock to optimize productivity, maximize genetic diversity, minimize genetic loss, and maintain genetic balance.

Management under the current captive-breeding protocols should continue to emphasize optimal productivity, maximum genetic diversity, minimum genetic loss, and genetic balance.

121. Maintain comparable genetic, age, and sex representation in each facility.

Because of the possibility of a catastrophic loss at one or more captive breeding facilities, each sub-population should be managed to represent as much as possible the captive population as a whole.

122. Offspring and eggs should be exchanged between captive sub-populations to simulate immigration.

The exchange of offspring and eggs should be conducted as needed to balance the genetic, age, and sex ratios of the sub-populations.

125. Determine an appropriate genetic balance in the California condor captive flock.

Continue research on the genetic relatedness of the captive flock and generate a computer model to determine an appropriate genetic balance in the captive flock.

126. Establish optimum pairing strategies for the California condor captive flock.

Optimum pairing strategies should continue to be based on the most current genetic and behavioral information, logistical considerations, and any other pertinent data.

13. Manage selected California condors for release to the wild.

California condors to be released to the wild should be genetically expendable, physically and behaviorally healthy, of comparable age, successfully socialized with other release candidates, and kept in isolation from humans to prevent taming. Criteria to identify condors eligible for release should continue to be refined by the Team.

14. Collect and analyze behavioral data on captive California and Andean condors.

Behavioral data on California and Andean condors have been collected and analyzed from the beginning of the captive-breeding program. Collection of such data in a standardized manner should continue, and emphasis should be placed upon publishing summaries of the findings, since they may have relevance to the management of the wild California condor population.

2. Reintroduce California Condors to the Wild.

Establish at least two, preferably more, disjunct wild sub-populations in order to reduce the risks to the overall population and to facilitate their optimal genetic and demographic management.

21. Develop protocols for the releases of California condors.

Draft release protocols were completed in July of 1991, based on data collected during the experimental releases of Andean condors. They should be updated and revised based on data collected from the three releases of California condors.

211. Develop release criteria for California condors.

Criteria to determine eligible release candidates have been developed, but should be reviewed and updated as needed.

212. Develop an annual plan for the release of California condors.

Based on the annual production of release candidates and the physical capacities of the current release site(s), prepare a release plan that would recommend procedures for (1) the selection of release cohorts, (2) the socialization of release cohorts in captivity, (3) the transfer from captive facilities to release sites, (4) veterinary care, (5) feeding schedules, and (6) pre- and post-release monitoring.

22. Establish release sites in California for California condors.

Two California condor release sites in California have been established. Two releases were conducted in 1992 in the Sespe Condor Sanctuary, Ventura County and in 1993, another release was conducted in Lion Canyon, Santa Barbara County. Additional release sites should be selected to accommodate any unexpected needs to move the existing release operations, as well as to accommodate an increasing number of releasable birds.

221. Develop criteria for selecting release sites for California condors.

Criteria for selecting release sites have been developed, but should be revised if necessary, based on information collected from the current release operation.

222. Select release sites in accordance with established criteria.

Continue to select release sites on an as needed based on the established release site selection protocols.

223. Prepare release sites based on protocols resulting from the Andean condor experimental release results and information learned from the three recent California condor releases.

Preparation of future release sites should utilize the existing release protocols and incorporate the knowledge gained from past releases of Andean and California condors and revised as new findings become available.

23. Conduct releases in California of California condors into selected habitats.

Three California condor releases have already been conducted and more should be scheduled on an annual basis until the recovery goal is met.

231. Develop a California condor release plan.

A plan outlining the management of releases in California should be developed to project at least five years into the future to insure adequate support for proposed releases.

232. Release California Condors.

Since January of 1992, three California condor releases have been conducted with a total of 13 birds released. Releases should continue on an annual basis as long as eligible release candidates are available.

233. Monitor California condors held at release sites in accordance with the annual release plan and established protocol.

The specific guidance provided in the plan and existing protocols should be followed to guarantee the health and safety of the birds being held for release.

234. Monitor free-flying condors.

Released California condors should be closely monitored by visual observation and electronic telemetry.

235. Provide protection for released birds.

Protection should be provided by land management agreements (e.g., closures and conservation easements), patrolling wildlife authorities, and biologists tracking the released birds.

24. Following the procedures outlined in tasks 21 through 23, implement releases of California condors outside California.

The two approved future release sites located outside California should be managed according to the criteria and protocols developed for condor releases in California. Experimental releases of Andean condors at these release sites may be recommended.

241. Release California condors in northern Arizona.

Release California condors at this approved site in accordance with established release protocols.

242. Release California condors at Ladder Ranch, New Mexico.

Release California condors at this approved site in accordance with established release protocols.

3. Provide Adequate Habitat for Condor Recovery in the Wild.

The successful establishment of viable wild California condor sub-populations will depend on the existence of suitable habitat. Therefore, all suitable habitat should be managed for the recovery of the California condor.

31. Continue to implement management plans to protect known suitable nesting sites within recent historical condor range.

Continue the enforcement of adopted guidelines that protect known and potential condor nest sites from activities that could adversely modify or destroy them and provide adequate protection against human disturbance.

32. Continue to implement management plans to protect known suitable roosting sites.

Continue the enforcement of adopted guidelines that protect known and potential roost sites from activities that could adversely modify or destroy them, and provide adequate protection against human disturbance.

33. Provide optimal foraging habitat.

Sufficient Uncontaminated foraging habitat free of human disturbance should be preserved inorder to guarantee the successful reestablishment of wild condor subpopulations in the recent historical condor range.

331. Implement strategies for managing condor foraging habitat.

Key foraging habitats have been identified and documented through observations and radiotelemetry. Their preservation is essential to establishing and maintaining viable wild populations of California condors. Habitat management plans and land use agreements on Federal, State, and private lands should be developed and implemented to protect key foraging habitats.

3311. Encourage land managers and owners to leave dead livestock on rangelands.

Wild California condors traditionally fed on dead livestock found on private and public rangelands. In the future, such carcasses should provide an important food source for released condors. Non-contaminated carcasses should be provided for condors, unless their placement poses a threat to foraging birds. Land managers should be informed of the value of these carcasses, and they should be encouraged to leave dead livestock out for condors.

3312. Reestablish extirpated native ungulate populations on historical foraging grounds.

Encourage the Department in cooperation with land management agencies to initiate or accelerate any native ungulate reintroduction project being considered or underway within the range of the California condor.

332. Preserve key feeding areas near nests and roosts.

Viable, uncontaminated, and undisturbed feeding habitat is essential, if California condors are to successfully reoccupy these key foraging, roosting, and nesting areas.

3321. Foothills of southwestern Kern County.

The foothills of southwestern Kern County were heavily used by condors throughout the year. Two or more breeding pairs and several individuals fed there at all times of the year, and virtually the entire condor population fed there in late summer and fall. The area is principally comprised by three large, private cattle ranches in southern Kern County: San Emigdio, Snedden, and Hudson. Dead livestock were the primary food source for condors while feeding in this area. A land protection plan should be prepared to determine the most appropriate way to preserve this important area.

3322. Carrizo Plain, San Luis Obispo and Elkhorn Plains, Kern County.

The Carrizo and Elkhorn Plains in southeastern San Luis Obispo County and southwestern Kern County, were used for feeding by California condors year around with the heaviest use being recorded in late winter and spring. Through a series of large land purchases and exchanges, the Bureau of Land

Management (BLM) has been able to secure most of this area as a wildlife preserve. It is currently jointly managed by the BLM, The Nature Conservancy, and the Department as the "Carrizo Plain Natural Area." The remaining private inholdings should be purchased and added to the wildlife preserve.

3323. <u>Tulare County rangelands between Lake Kaweah and White River</u>.

California condors fed in this area throughout the year with particularly heavy use in summer, fall and early winter. It appeared to be an important foraging area for condors, particularly nonbreeders. Efforts should be made to encourage continuation of a livestock-based economy.

3324. <u>Glennville/Woody areas, Kern County</u>.

This key feeding area in northern Kern County received heavy use by foraging California condors, particularly between late fall and late spring. Efforts should be made to encourage continuation of a livestock-based economy.

3325. <u>Tejon Ranch area, Kern County</u>.

The Tejon Ranch was an extremely important condor feeding area throughout the annual cycle, especially in the fall, this may be due to the high intensity of deer hunting activity on the ranch. At least one breeding pair was suspected to have fed there on a regular basis. A land protection plan addressing the future needs of the condor should be prepared for this critical area.

3326. <u>Hopper Mountain Ranch area, Ventura, County</u>.

The Hopper Mountain Ranch area was purchased in 1974 to serve as a buffer against development for the Sespe Condor Sanctuary (Sanctuary) and to provide an area for a condor feeding program. It is now a National Wildlife Refuge and the existing ranch house was used as the headquarters for the condor field program that monitored the wild population of California condors. It should be maintained as a refuge to protect the Sanctuary.

3327. Bitter Creek National Wildlife Refuge, Kern County.

The Hudson Ranch area was purchased in 1983, because it was an important feeding area for California condors, and it became the Bitter Creek National Wildlife Refuge. As a refuge, its primary management emphasis should be to support ungulates as a food source for condors.

3328. San Juan Creek Region, San Luis Obispo County.

Rangelands on either side of the entire San Juan Creek drainage were important as California condor feeding areas. In the early 1980's, foraging flights by radioed condors were recorded in the upper drainage of San Juan Creek south of Highway 58. During this period, a pair of non-radioed breeding condors and, occasionally, non-radioed single condors were observed there during the summer months. The area should be maintained in a livestock-based economy.

3329. Elkhorn Hills, Kern County and Caliente Range, Kern County and San Luis Obispo County.

These areas were regular California condor foraging areas. In the future, as the population of wild condors increases, the use of these areas by foraging condors will probably resume. The management emphasis in these areas should be the reintroduction of extirpated ungulate species.

34. Continue to monitor potential impact of all surface-disturbing activities (e.g., energy, residential, agricultural, and transportation development projects) within recent historical condor range.

The increasing pressure to develop land within the recent historical California condor range is increasing. Therefore, studies to identify, assess, and monitor potential threats should continue in order to develop viable alternatives to avoid impacts to California Condors.

341. Work with governmental agencies to include information on the condor in land-use planning documents, geographic information systems, and policies.

Routine and close communication should be maintained with appropriate governmental planning agencies (Federal, State, and County), in order to ensure that information on California condor distribution and habitat use is integrated into the land planning process.

342. Review the status of all general plans and land use control programs in the condor's range to recommend appropriate protection and mitigation measures as necessary.

An attempt should be made to review all local land-use planning documents and attend all pertinent local governmental planning meetings to ensure California condor issues are addressed. Appropriate protection and mitigation measures should be included in any land-use documents involving lands within the California condor's recent historic range.

4. Minimize Mortality Factors in the Natural Environment.

Land management agencies should identify all known California condor mortality factors in their land resource management plans and develop strategies to eliminate or mitigate for them.

41. Assess historical findings.

A review of the historical literature should be conducted to compile information on potential mortality factors. It should be determined if these mortality factors are still a threat. If so, corrective actions should be taken to eliminate them.

42. Provide adequate law enforcement to minimize direct losses of wild condors from shooting.

A cooperative law enforcement program should be developed and implemented between the Department, Forest Service, and Service for the patrol of key condor areas.

43. Implement management recommendations and strategies to minimize contaminant-related mortality factors.

Land management agencies should identify all known or suspected sources of contaminants that could poison California condors. These land managers should then implement management strategies to eliminate the source, use, or dumping of these contaminants on lands under their jurisdiction.

44. Eliminate or reduce the effects of environmental contaminants on California condor.

Initiate research on known and suspected environmental contaminants using surrogate species to determine their effects on the survival and reproduction of California condors. Based on the findings of this research, management recommendations should be made that would eliminate or reduce these effects on condors.

441. Determine effects of various poisons and contaminants, especially lead, on surrogate species.

Continue to compile information on the effects of various poisons and contaminants on surrogate species, especially the turkey vulture and Andean condor, to provide comparative data of particular relevance to the California condor.

45. Monitor contaminant levels in California condors.

Condor blood, feathers, eggshells, and other tissues will be collected opportunistically and analyzed for heavy metals, pesticides, and other potential contaminants.

451. Sample potential condor food items within recent historical range to determine seasonal and geographic contaminant loads.

Once California condors find and start feeding on food items other than the carcasses provided to them, those specific items should be tested to determine their contaminant burdens.

452. Sample blood of surrogate sympatric species in the field to determine seasonal and geographic distribution of contaminant loads.

Blood samples should be taken from species (e.g., golden eagle) that are permanent residents within the range of the California condor. Samples should be taken throughout the condor's range and during each season.

46. Minimize mortality due to collisions with man-made structures.

Increasing development within the California condor's range makes it imperative that all is done to minimize collisions with man-made structures by developing guidance documents that would eliminate or mitigate condor deaths due to collisions with man-made structures.

461. Assess avian mortality resulting from collisions with wind turbines, power lines, and other man-made structures.

To assess the magnitude of avian mortalities due to collisions with man-made structures, all available information on the subject should be collected, knowledgeable persons interviewed, and further studies conducted, if necessary. The information collected should be summarized and reviewed by the Team.

462. Advise planning agencies on location of and mitigation for power lines, wind turbines, and other structures to avoid possible condor mortalities.

In 1966, a California condor was killed when it flew into a power line. In a six-month period from May to October 1993, three juvenile condors died when they collided with power lines. Death resulting from collisions with man-made structures (e.g., power lines and wind turbines) is mitigatable if such structures are designed or retrofitted with hardware that discourages condors from perching on them and also through carefully planned placement. All agencies/companies planning the construction of such structures should be advised on the most favorable location of such structures from the standpoint of the condor, as well as mitigation measures necessary to avoid possible condor mortalities.

47. Develop strategies for controlling natural potential predators of condor eggs and nestlings in nesting areas.

Studies should be undertaken to develop aversion techniques that would stop or discourage known predators such as ravens and golden eagles from preying on California condor eggs and nestlings.

48. Restrict aircraft activity in key condor areas.

Low flying military and civilian aircraft could collide with and cause the death of soaring California condors in certain key areas and could disrupt feeding, nesting, and roosting condors. The Federal Aviation Administration should be persuaded to issue aircraft activity advisories in order to protect the airspace in these areas for condors.

5. Implement Information and Education Programs on Condor Habitat Use and Protection Needs.

Information and education programs are currently administered by the Team, Condor Working Group, and the individual agencies and institutions participating in the California condor recovery effort. These programs should continue and should coordinate with one another in order to be consistent and more efficient and to avoid any duplication of effort.

51. Distribute educational material about condor habitat, species identification, and legal protection.

Educational hand-out materials on habitat needs, condor identification, and existing laws protecting condors are useful tools for disseminating information to the public. New material should be developed, existing material should be revised and updated periodically.

52. Provide information to key governmental land managers in condor range.

Written and visual information packets, presentations, and newsletters are currently provided to key governmental land managers. This level of communication should continue in order to meet the informational needs of these land managers.

53. <u>Provide information on condor habitat needs to key private landowners.</u>

Information packets, presentations, and newsletters are currently provided to key private landowners. This level of communication should continue in order to meet the informational needs of these private landowners.

54. <u>Establish observation points and educational facilities at selected sites</u>.

Existing observation points should be rehabilitated, information updated, and new observation sites should be developed within key areas accessible to the public in the range of newly released California Condors.

55. <u>Make a video on California condor recovery effort for use as an educational tool by all cooperating agencies and groups</u>.

Continue to video tape of the California Condor field and captive breeding programs to produce up to date visual material for public education.

56. <u>Provide training sessions on condor biology, ecology, and key use areas to law enforcement agents</u>.

Currently, a condor workshop is conducted once a year to educate law enforcement officers, land managers, biologists, and private citizens that work or live in key use areas. This annual workshop should be conducted as long as condors are released to the wild.

57. <u>Develop public information about condor recovery programs at zoological institutions</u>.

Existing public information programs at zoological institutions should continue to provide the public important information on the California Condor recovery efforts.

571. <u>Provide informational kiosks</u>.

Without California condors on exhibit it is necessary that information on the captive breeding program be displayed using informational kiosks to keep the public informed on the progress of the condor recovery effort. These kiosks should be available to the public at the San Diego Wild Animal Park, Los Angeles Zoo, and World Center for Birds of Prey.

572. Exhibit California condors at zoological institutions.

At selected zoological parks supporting California condor captive breeding facilities, condors should be placed on exhibit to educate the public on the current recovery effort.

573. Continue to provide photos and video tapes of captive-rearing efforts to the press and management agencies of educational use.

The sensitive nature of the captive-rearing program necessitates that it be off-exhibit and closed to the public. It is therefore, important that photos and video tapes be made available to keep the public informed and management agencies supplied with California condor captive-rearing educational information.

58. Maintain and make available a computerized, literature-based condor information system.

Convert the existing California Condor Program literature archives to a computerized literature-based condor information system.

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Wright, J.M., M. Treadwell, R.K. Nurthen, L.M. Woodworth, M.E. Montgomery, D.A. Briscoe, and R. Frankham. Unpubl. ms. Modeling problems in conservation genetics using Drosophila: purging is ineffective in reducing genetic load.

III. IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for this recovery program. It is a guide to meet the objectives of the California Condor Recovery Plan. This table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible to perform these tasks, a time-table for accomplishing these tasks, and the estimated costs to perform them. Implementing Part III is the action of this plan, that when accomplished, will satisfy the recovery objective. Initiation of these actions is subject to the availability of funds.

Priorities in Column 1 of the following implementation schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

<u>Codes used in Implementation Schedule</u>

Ongoing = Task is currently being implemented and will continue until action is no longer necessary for recovery.

* = Lead Agency

Total Cost = Projected cost of task from task start to task completion.

Responsible Parties:

USFWS = U.S. Fish and Wildlife Service
USFS = U.S. Forest Service
USBLM = U.S. Bureau of Land Management
CDFG = California Department of Fish and Game
TNC = The Nature Conservancy
LAZ = Los Angeles Zoo
SDWAP = San Diego Wild Animal Park
PF = Peregrine Fund
CCRT = California Condor Recovery Team
CEC = California Energy Commission

Recovery Plan Implementation Schedule for the California Condor

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	COMMENTS
		1: Captive Breeding									
1	111	Management Protocols	1	LAZ*SDWAP*PF* USFWS	5	5					
1	112	Operate Facilities	Ongoing	LAZ-SDWAP-PF	1,250	250	250	250	250	250	
1	113	New Captive Breeding Facilities	Ongoing	CCRT*USFWS CDFG	10	10					
1	12	Manage Captive Flock	Ongoing	LAZ-SDWAP-PF	1,250	250	250	250	250	250	
1	121	Maintain: Genetic, Age,& Sex Balance	Ongoing	LAZ-SDWAP-PF	5	1	1	1	1	1	
1	122	Offspring & eggs Exchange	Ongoing	LAZ-SDWAP-PF	10	2	2	2	2	2	
1	123	Determine Genetic Balance	Ongoing	LAZ-SDWAP-PF	10	2	2	2	2	2	
1	124	Develop & Implement Pair Strategies	Ongoing	LAZ-SDWAP-PF	10	2	2	2	2	2	
1	13	Manage Selected Condors for Release	Ongoing	LAZ-SDWAP	15	3	3	3	3	3	
1	14	Behavioral Data	Ongoing	LAZ-SDWAP-PF	150	30	30	30	30	30	
		1: Subtotal Needs			2715	563	548	548	548	548	
		2: Reintroductions									
2	21	Develop Release Protocols	1	USFWS*CCRT	10	10					
2	211	Release Criteria	1	CCRT-USFWS	1	1					
	212	Annual Release Plan Release Criteria	Ongoing	USFWS	50	10	10	10	10	10	
2	221	Release Site Selection Criteria	1	CCRT-USFWS	1	1					
2	222	Select Release Sites	3	CCRT-USFWS	30		10	10	10		

Recovery Plan Implementation Schedule for the California Condor

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	COMMENTS
2	223	Prepare Release Sites	3	USFWS	30		10	10	10		
2	23	Conduct Releases	5	USFWS	2,250	450	450	450	450	450	
2	231	Develop California Release Plan	1	USFWS	5	5					
2	232	Release Condors	5	USFWS	50	10	10	10	10	10	
2	233	Monitor Condors at Site	5	USFWS	250	50	50	50	50	50	
2	234	Monitor Free-Flying Condors	Ongoing	USFWS	250	50	50	50	50	50	
2	235	Protect Released Condors	5	USFWS-CDFG USFS	250	50	50	50	50	50	
2	241	Northern Arizona Release	3	USFWS-State	450			150	150	150	
2	242	New Mexico Release	3	USFWS-State	450			150	150	150	
		2: Subtotal Needs			3827	587	590	890	890	870	
		3: Habitat									
3	31	Protect Nest Sites	Ongoing	USFWS-USFS* USBLM-CDFG BIA	10	2	2	2	2	2	
3	32	Protect Roost Sites	Ongoing	USFWS-USFS USBLM-CDFG BIA	10	2	2	2	2	2	
3	331	Manage Condor Foraging Habitat	Ongoing	USFWS-USFS USBLM-CDFG	10	2	2	2	2	2	
3	3311	Dead Livestock on Rangelands	Ongoing	USFWS-USFS USBLM-CDFG	5	1	1	1	1	1	
3	3312	Reestablish Native Ungulates	Ongoing	CDFG*USBLM USFS-USFWS	20	4	4	4	4	4	

Recovery Plan Implementation Schedule for the California Condor

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	COMMENTS
3	3321	S.W. Kern Co.	Ongoing	CDFG-USBLM County	5	1	1	1	1	1	
3	3322	Carrizo & Elkhorn Plains	Ongoing	USBLM*CDFG TNC	100	20	20	20	20	20	
3	3323	Tulare County Grasslands	Ongoing	CDFG-County	5	1	1	1	1	1	
3	3324	Glennville Woody Area	Ongoing	CDFG-County	5	1	1	1	1	1	
3	3325	Tejon Ranch	Ongoing	CDFG-County	5	1	1	1	1	1	
3	3326	Hopper Mtn.	Ongoing	USFWS-USFS USBLM-CDFG	100	20	20	20	20	20	
3	3327	Bitter Creek	Ongoing	USFWS	50	10	10	10	10	10	
3	3328	San Juan Creek	Ongoing	CDFG- County	5	1	1	1	1	1	
3	3329	Elkhorn Hill & Caliente Range	Ongoing	CDFG-County	25	5	5	5	5	5	
3	341	Land Use Planning	Ongoing	USFWS-USBLM USFS-CDFG BIA	15	3	3	3	3	3	
3	342	General Plan Review	Ongoing	CDFG-USFWS	20	4	4	4	4	4	
		3: Subtotal Needs			415	83	83	83	83	83	
		4: Mortality									
4	41	Assess Historical Findings	Ongoing	USFWS	10	2	2	2	2	2	
4	42	Law Enforcement	Ongoing	CDFG*-USFWS USBLM-USFS	25	5	5	5	5	5	
4	43	Minimize Contaminant Related Mortality	Ongoing	USFWS-USFS USBLM-CDFG	25	5	5	5	5	5	
4	43	Monitor Contaminants	Ongoing	USFWS	10	10					

Recovery Plan Implementation Schedule for the California Condor

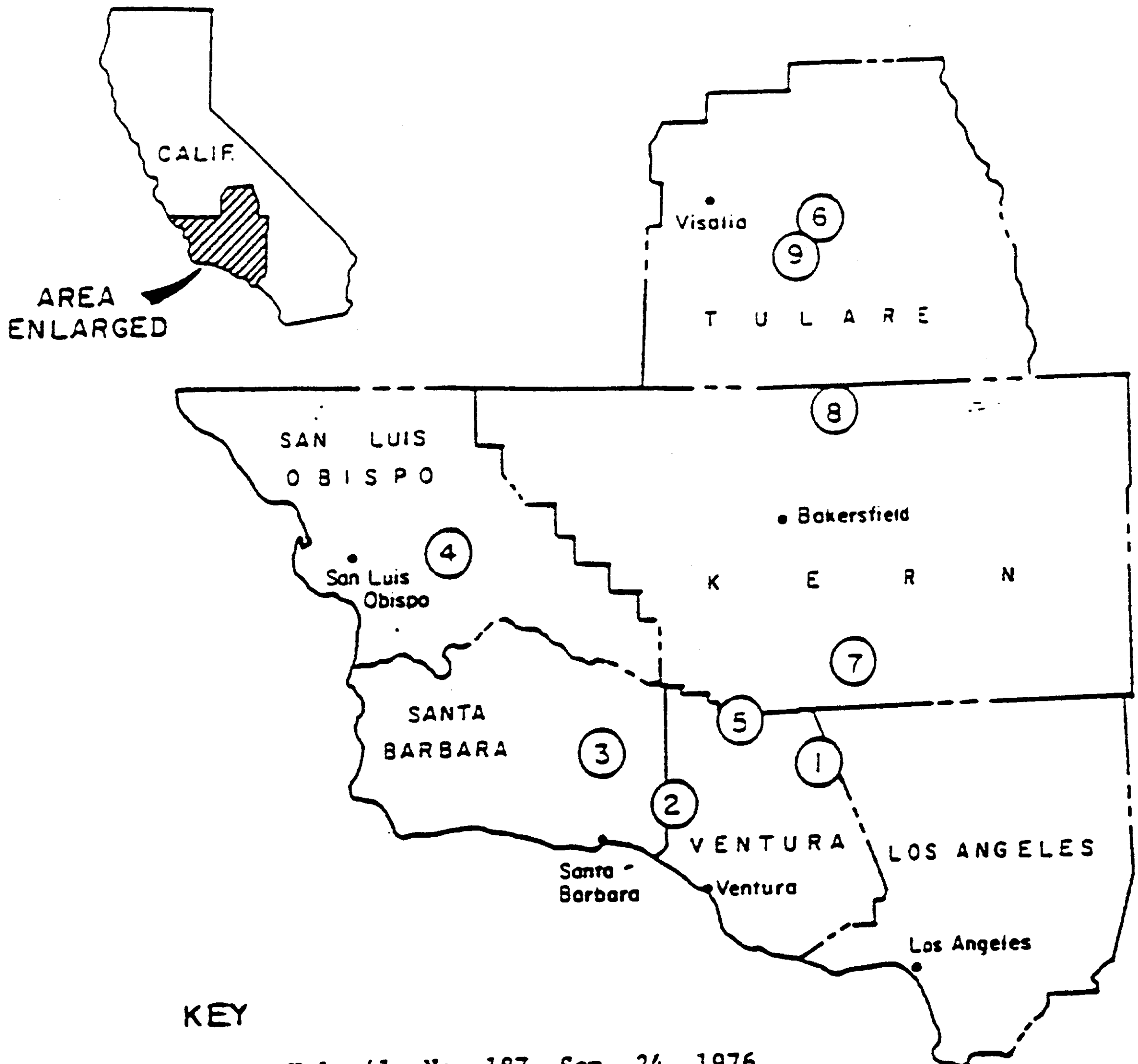
PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	COMMENTS
						COST ESTIMATES ($1,000)					
4	441	Determine Effects Contaminants	3	USFWS	165		55	55	55		
4	451	Sample Food for Contaminant Loads	3	USFWS	75			25	25	25	
4	452	Blood Samples Contaminant Loads	Ongoing	USFWS-CDFG	25	5	5	5	5	5	
4	461	Avian Mortality due to Collisions with Human-Made Structures	Ongoing	CEC-USFWS Private Sector	500	100	100	100	100	100	
4	462	Advise Planning Agencies on Location & Mitigation to Avoid Collisions with Human-Made Structures	Ongoing	USFWS-CDFG	25	5	5	5	5	5	
4	47	Control Predators	3	USFWS	45		15	15	15		
4	48	Restrict Aircraft in Key Areas	Ongoing	USFWS-FAA	5	1	1	1	1	1	
		4: Subtotal Needs			910	128	193	218	218	148	
5	51	Distribute Educational Material	Ongoing	USFWS-USFS CDFG-USBLM LAZ-SDWAP-PF	25	5	5	5	5	5	
5	52	Provide Information to Land Managers	Ongoing	USFWS-USFS CDFG-USBLM	10	2	2	2	2	2	
5	53	Provide Information to Private Landowners	Ongoing	USFWS-USFS CDFG-USBLM	5	1	1	1	1	1	
5	54	Establish Points of Observations and Educational Facilities	Ongoing	USFS*USBLM* USFWS-CDFG	25	5	5	5	5	5	
5	55	Videos	Ongoing	USFWS-USFS CDFG-USBLM	50	10	10	10	10	10	

Recovery Plan Implementation Schedule for the California Condor

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	COMMENTS
5	56	Training Sessions	Ongoing	USFWS-USFS CDFG-USBLM LAZ-SDWAP-PF	10	2	2	2	2	2	
5	571	Zoo Kiosks	Ongoing	LAZ-SDWAP-PF	30	6	6	6	6	6	
5	572	Zoo Condor Exhibit	3	LAZ-SDWAP-PF	600			200	200	200	
5	573	Provide Photos & Videos	Ongoing	LAZ-SDWAP-PF	25	5	5	5	5	5	
5	58	Maintain Centralized Information Center	Ongoing	USFWS	5	1	1	1	1	1	
		5: Subtotal Needs			785	37	37	237	237	237	
		TOTAL COSTS			8652	1390	1451	1976	1976	1886	

APPENDIX I

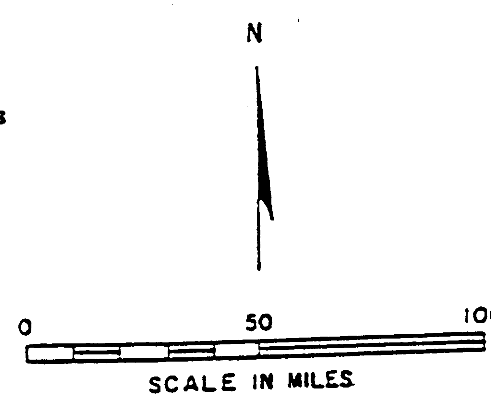
CALIFORNIA CONDOR CRITICAL HABITAT



KEY

Federal Register, Vol. 41, No. 187, Sep. 24, 1976
Paragraph 17.64 California Condor
(a)

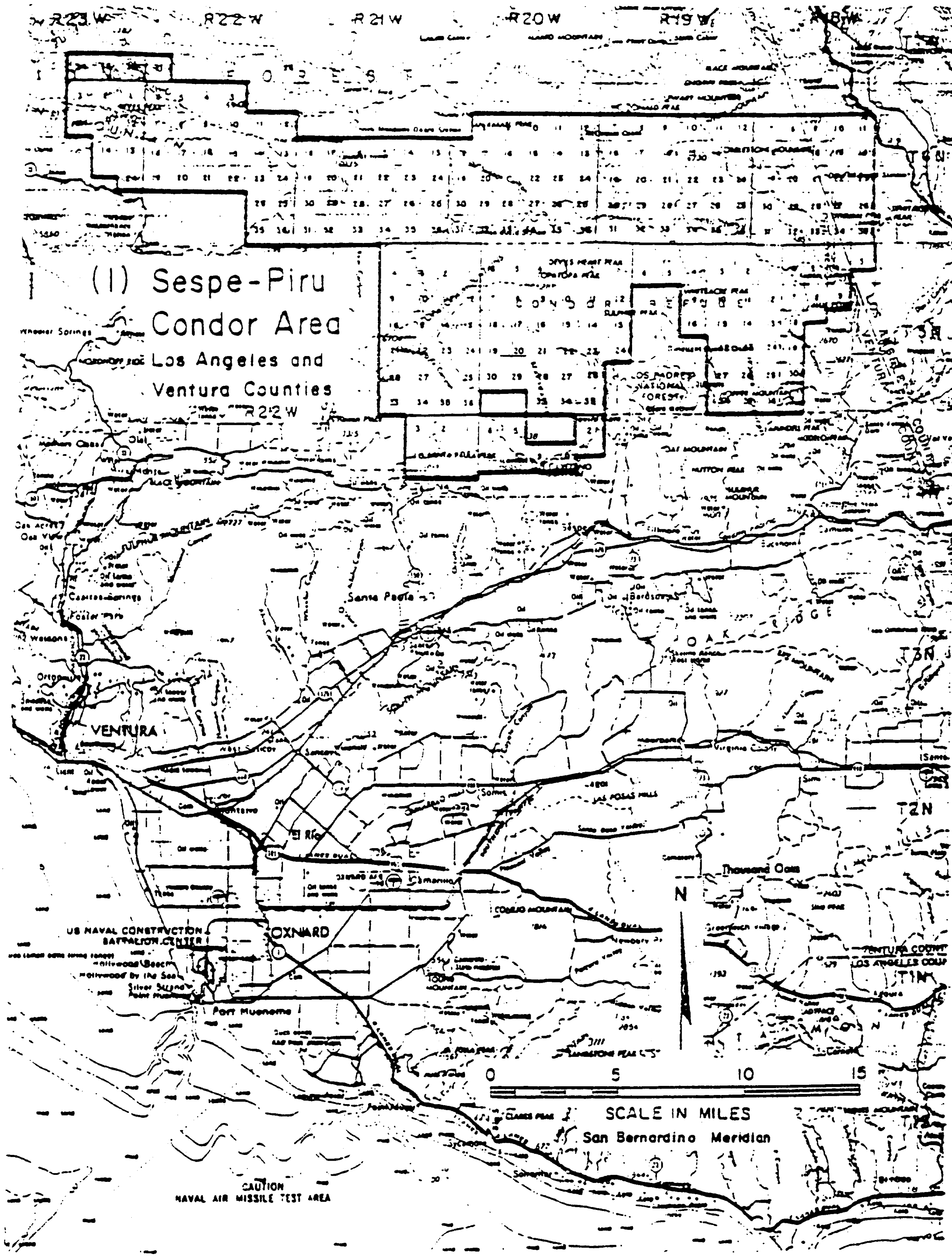
(1) Sespe-Piru Condor Area
(2) Matilija Condor Area
(3) Sisquoc-San Rafael Condor Area
(4) Hi Mountain-Beartrap Condor Areas
(5) Mt. Pinos Condor Area
(6) Blue Ridge Condor Area
(7) Tejon Ranch
(8) Kern County rangelands
(9) Tulare County rangelands



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

Sheet 1 of 7



DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

Reference: Federal Register, Vol. 41, No. 187, Sep. 24, 1976

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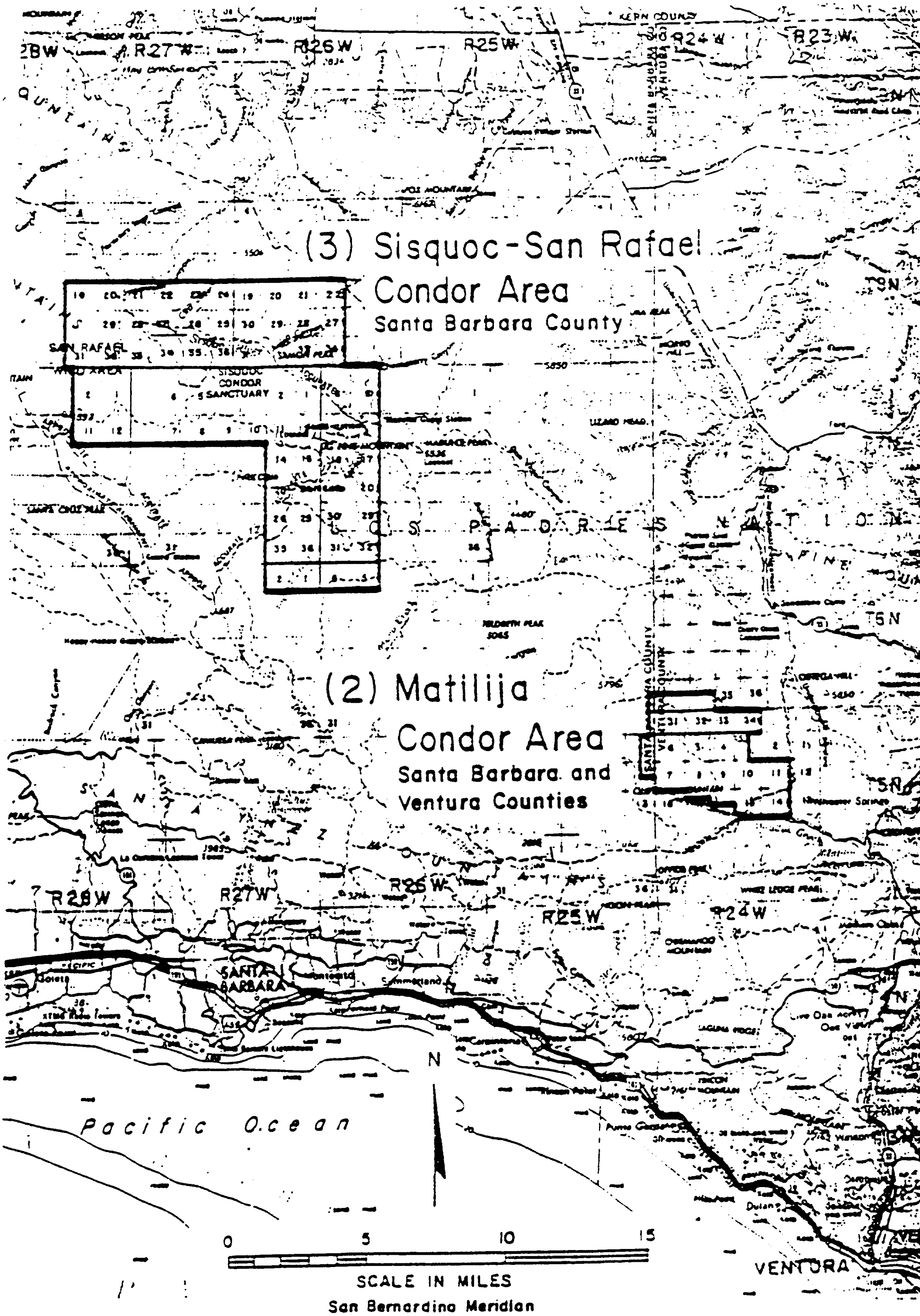

DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

Reference: Federal Register, Vol. 41, No. 187, Sep. 24, 1976

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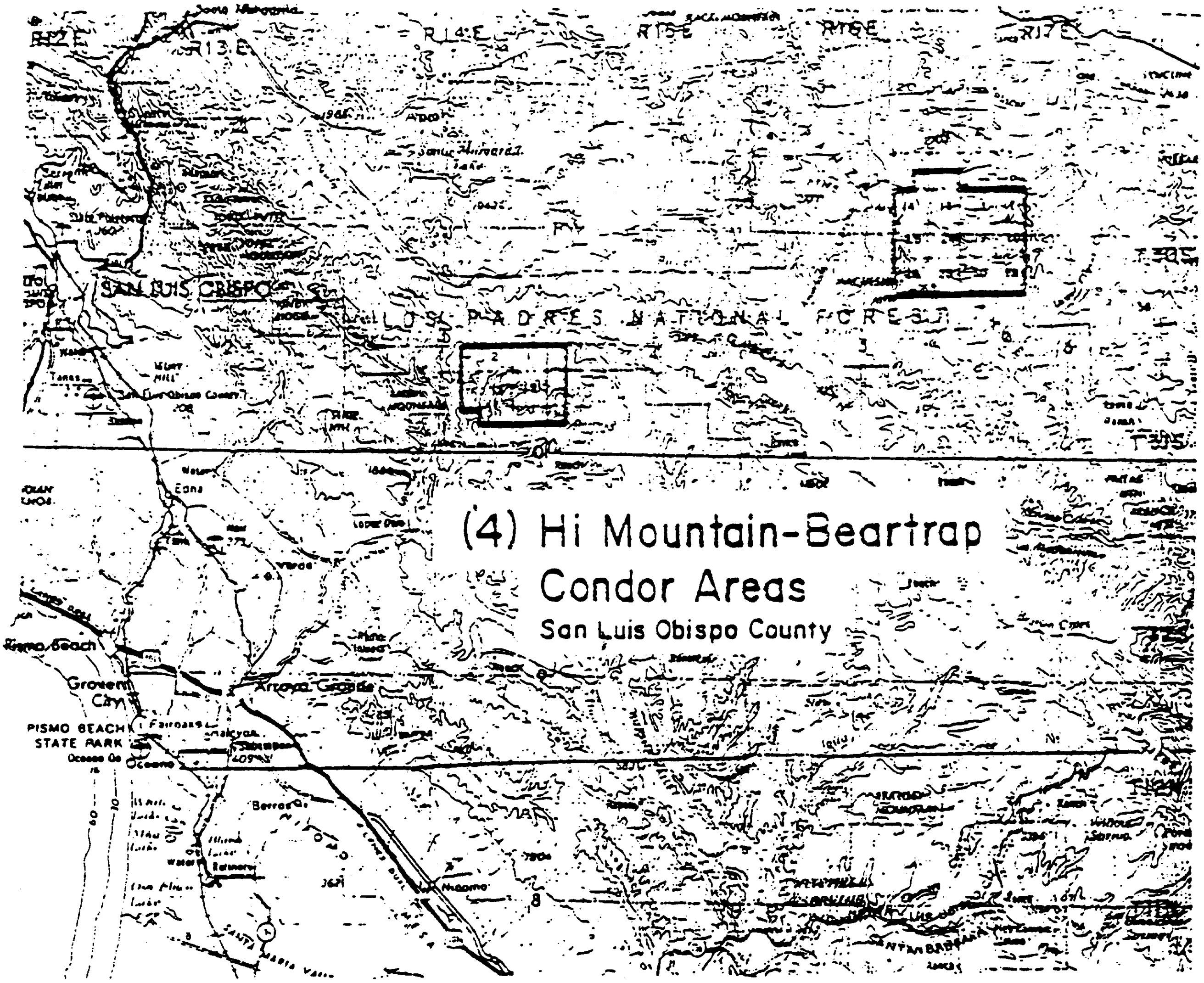

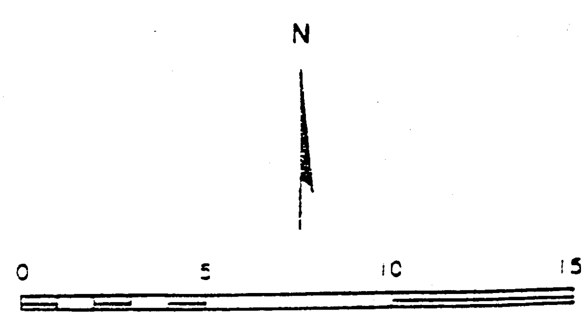

SCALE IN MILES

Mt. Diablo Meridian

DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

Reference: Federal Register, Vol 41, No 187, Sep. 24 1976

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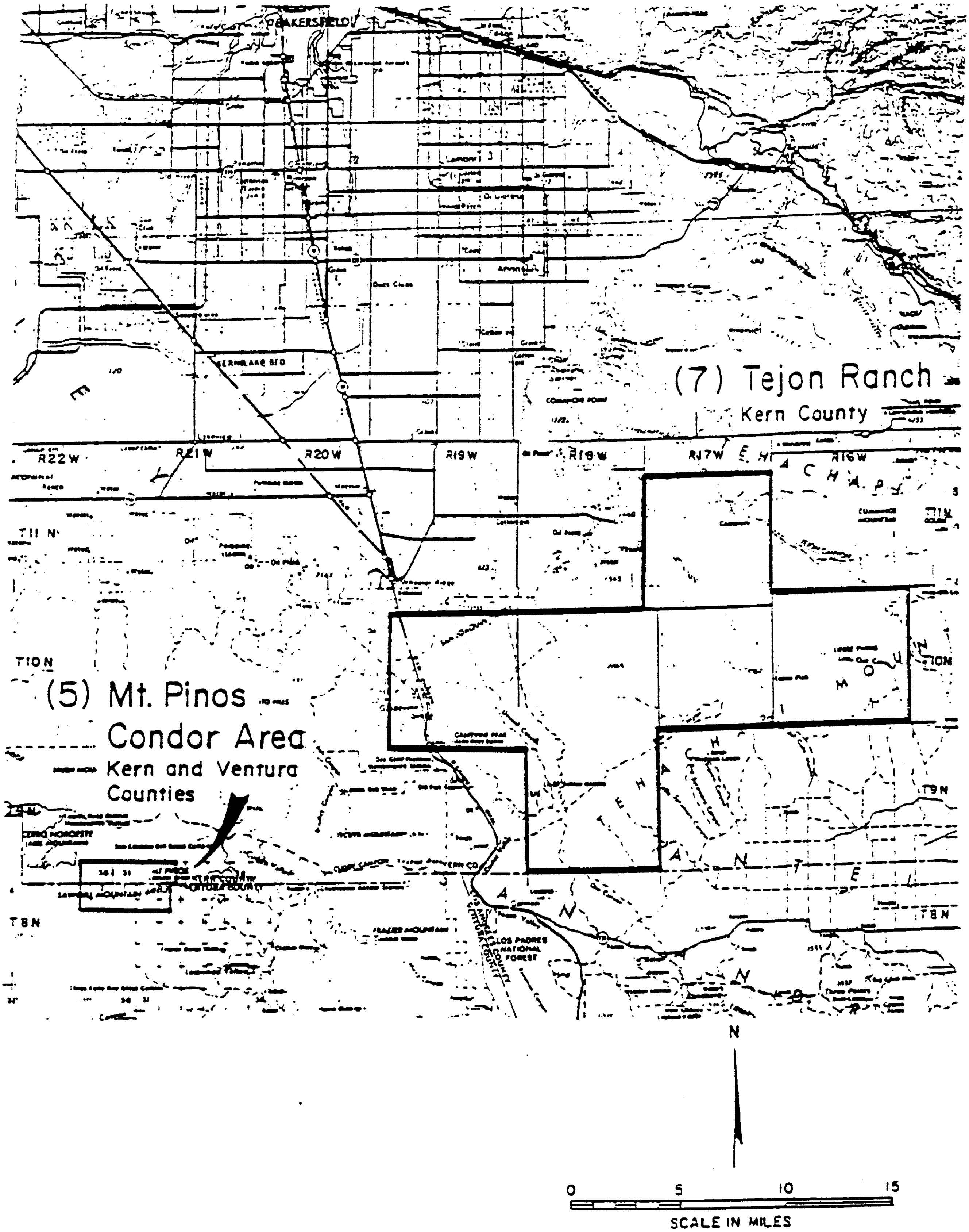

DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

Reference: Federal Register, Vol 41, No. 187, Sep. 24, 1976

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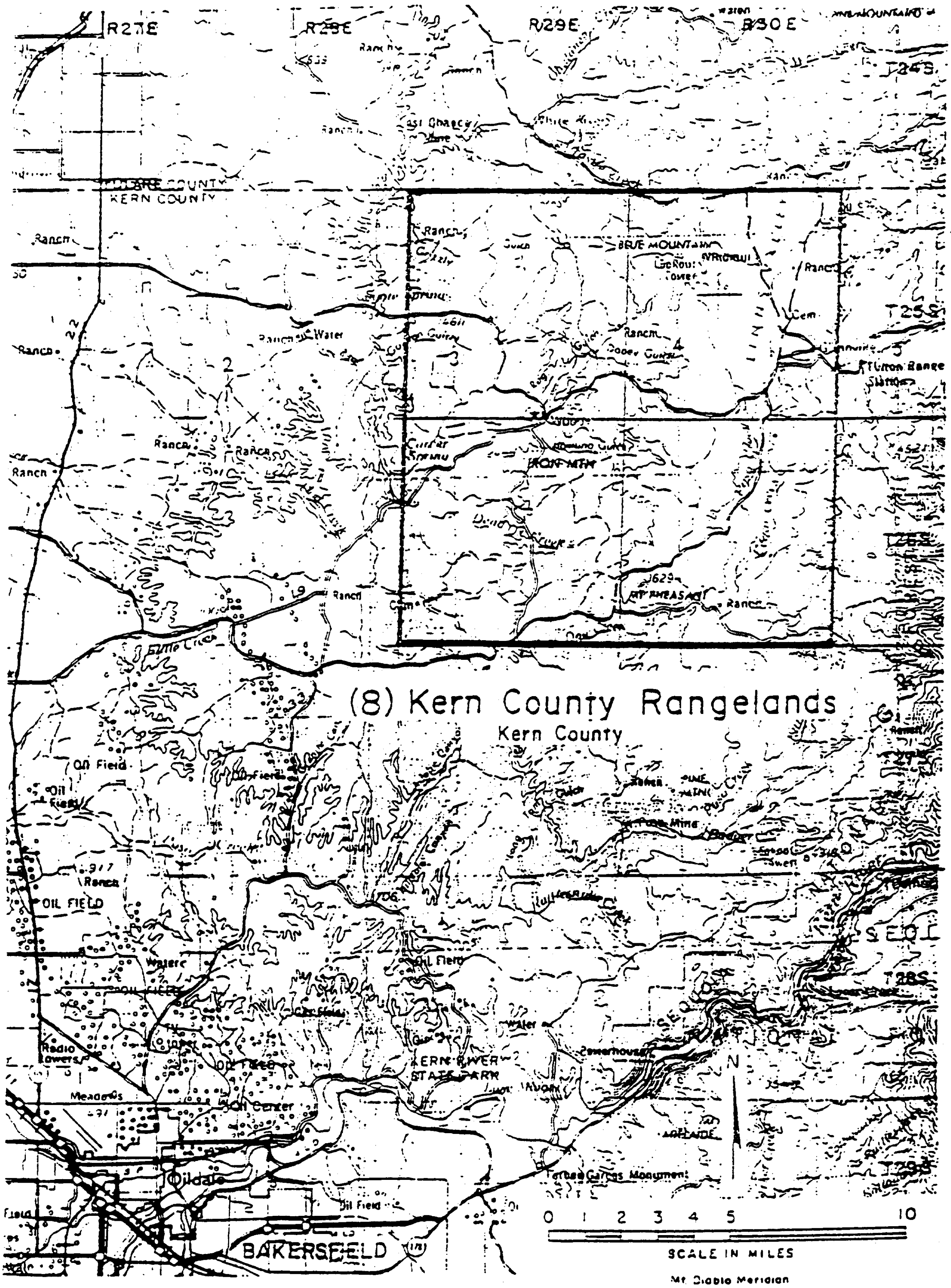

DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

Reference: Federal Register ... 1976

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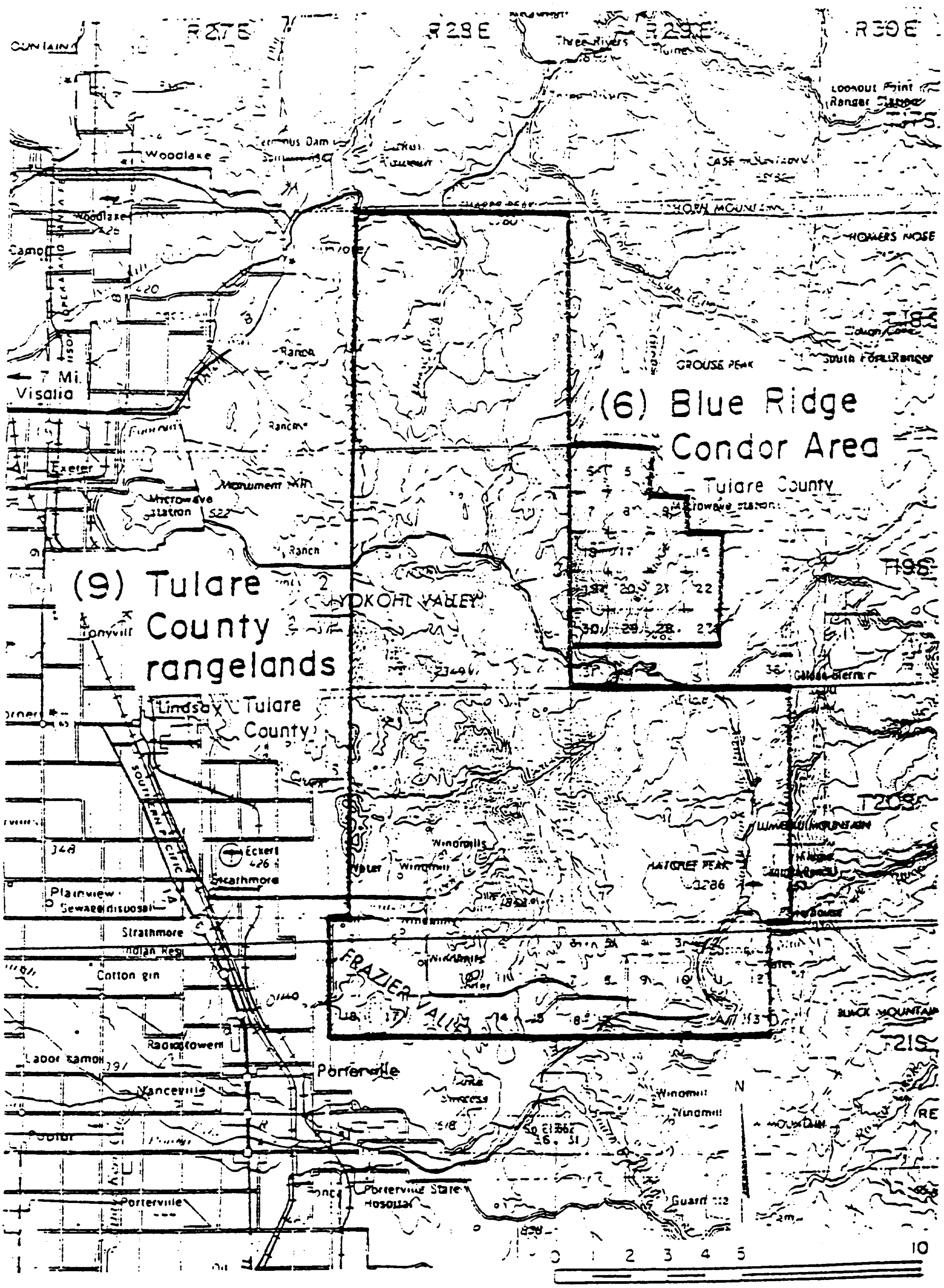

Mt. Diablo Meridian

DETERMINATION OF CRITICAL HABITAT
FOR
CALIFORNIA CONDOR

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APPENDIX II

Preliminary Population Viability Considerations

In small, closed populations, genetic criteria are thought to be very important. Small populations are more subject to genetic loss than large ones. The number of founders (as for a captive flock in a zoo), however, may have less impact on the loss of genetic variation than does the eventual size of the maintenance population (Senner 1980). For example, a founding group of even ten related individuals will include, on average, about 95 percent of the parent population (Frankel and Soulé 1981), although the level that is maintained for a given time interval depends on several other factors, especially the generation time and the rate of growth of the population following the bottleneck in numbers (Soulé et al. 1986).

The rate of loss of genetic variation depends on the *effective* size of the population. The concept of effective population size N_e, (the "variance effective number" of a population of N individuals, Franklin 1980:138--see Kimura and Crow 1963 and Lande and Barrowclough 1987 for a more detailed explanation), is central to an understanding of the role of genetic drift and inbreeding in the extinction of populations. N_e is rarely if ever equal to N, the number of breeding individuals in the population. Empirical studies show that it is often about 0.5N, but may drop below 0.1N for certain kinds of spatial (metapopulation) structure (Gilpin 1987). Important aspects of N_e related to planning for recovery of the California condor include:

1. N_e is more nearly equal to N in monogamous species, such as the California condor, than in polygamous species (Franklin 1980);

2. N_e is increased (up to twice N) when family sizes approach equality in breeding adults (Franklin 1980);

3. N_e can be as much as doubled by controlling mating to maximize the genetic difference between members of mated pairs (Senner 1980); and

4. Population crashes can substantially reduce the long-term average N_e (Franklin 1980).

Animal breeders have long known that the deleterious consequences of inbreeding (usually referred to as inbreeding depression) may preclude the long-term maintenance of small, closed populations (Conway 1980, Senner 1980). Symptoms of inbreeding depression are (1) lowered viability (failure to live to breeding age), (2) lowered fecundity, and (3) abnormal biases in sex ratios. These are thought to be the combined results of the loss of heterozygosity (reduced heterosis) and the fixation of harmful alleles (Allendorf and Leary 1986). Species differ, however, in this "genetic load" of harmful alleles. It is assumed that the California condor has a genetic load (frequency of bad genes) typical of animals in general. There are two reasons to expect a typical level. First, many large, relatively rare animals have significant levels of inbreeding depression (Ralls and Ballou 1983, Ralls et al. 1987). Second, it is unlikely that the species has been purged of its genetic load by having passed through a population bottleneck (Wright et al. ms.). This is because the current population probably represents the lowest ebb in the numbers during historic and pre-historic time.

The relationship between inbreeding and N_e is critical. The degree of inbreeding in a population, measured by the inbreeding coefficient (F), increases by about $1/2N_e$ per generation (see Lande and Barrowclough 1987 for details). In small populations, the fixation of deleterious genes by inbreeding and genetic drift cannot be counterbalanced by their selective elimination. The experience of animal breeders shows that a population cannot tolerate more than about 1 to 3 percent inbreeding per generation (Soulé 1980, Franklin 1980). $N_e = 50$, with random mating, will keep the inbreeding below a 1 percent level. However, the homozygosity of such a population will still increase by about 25 percent in 20 to 30 generations (Soulé 1980), assuming an average generation time of 8 years (Verner 1978).

We cannot precisely determine N_e for a population of California condors just from knowledge of the number of breeding adults. Because this species is apparently life-long monogamous and has a uniform clutch size of one (increasing the likelihood that each breeding adult will contribute equally to annual recruitment), its N_e should be nearly equal to N.

The current population of 82 birds represents 14 individual founders. The DNA fingerprinting data indicate that some of the founders are closely related and identify three genetic groups, or "clans" (Geyer et al. 1993). Because all of the breeding individuals are in captivity and matings can be controlled, the level of inbreeding in the population can be controlled. Nevertheless, some loss of genetic variation is inevitable until the population is increased to a total population of 200 to 300 breeding individuals, the size at which mutation is expected to contribute about as much variation for quantitative traits as is lost by random events (Lande and Barrowclough 1987). (The number usually given is 500, but this assumes random mating; because part of the California condor population will be captively bred, the threshold number is lower.)

The principal reasons for requiring the establishment of at least two disjunct populations in the wild are the possibilities of catastrophe and disease. Localized events, including epidemics, might extirpate a single population, but the existence of two, geographically isolated and non-interacting populations will significantly reduce the vulnerability of the species as a whole. Similarly, continuing to maintain several disjunct captive populations is also desirable for the same reasons. The chances that three or more such populations would suffer simultaneous catastrophes are very low.